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Technical Memorandum 33-736

Volume III

Mission Design Data for Venus, Mars, and Jupiter Through 1990

Andrey B. Sergeyevsky

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JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA

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PREFACE

This document is divided into three volumes. Volume I comprises the mission design data for Venus, Volume II the data for Mars, and Volume III the data for Jupiter.

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MISSION DESIGN DATA FOR VENUS, MARS AND JUPITER THROUGH 1990

Andrey B. Sergeyevsky

A. INTRODUCTION

This document presents mission design data for direct transfer trajectories from Earth to three planets – Venus, Mars and Jupiter, extending previously published information (see Refs. 1, 2, 3, 4 and 5) through the 1990 departure opportunity.

The primary purpose of this effort is to provide the mission analyst with graphical information, sufficient for preliminary mission design and evaluation. The data follows closely the format of Reference 4 and reflects methods of Reference 2. A specially modified version of the Space Research Conic Program (SPARC) (see Ref. 6) was used to generate the trajectory information presented. The data were automatically contour-plotted on the SC4020 plotter using the General Plot Program (GPP) (see Ref. 7), then hand-retouched and labeled. A special program (VIEWPE) was constructed to provide planetary positional data in graphical form, plotted on the SC4020, and presented in original format.

The data are arranged in three sections by arrival planet, in natural sequence. Each section consists of two parts – the trajectory characteristics for all available opportunities to the particular planet, in chronological order, followed by that planet's positional data for every calendar year, from 1975 to 1995.

The persevering and encouraging insistence of management, especially that of Mr. Willard E. Bollman to carry this effort through to completion, as well as the graphic and editorial support of Mr. Richard W. Rackus are gratefully acknowledged.

B. DESCRIPTION OF TRAJECTORY CHARACTERISTICS DATA

1. General

The data represent trajectory performance information plotted in the departure date/arrival date space, thus defining all possible transfer trajectories between the two bodies, within the time-span considered. Fourteen individual parameters are contour-plotted on the departure energy (C_3) background contour chart, for each opportunity. The following opportunities are presented:

To Venus:	1975, 1976/7, 1978, 1980, 1981, 1983, 1984/5, 1986, 1988, 1989/90.
To Mars:	1979, 1981/2, 1983/4, 1985/6, 1988, 1990.
To Jupiter:	1977, 1978, 1979, 1980/81, 1981/82, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990.

2. Definition of Terms

The following parameters are displayed on the contour plots:

C_3 Earth departure energy (km^2/sec^2); same as the square of departure hyperbolic excess velocity $V_\infty^2 = C_3 = V_I^2 - 2GM/R_I$, where

V_I = conic injection velocity (km/sec)

GM = gravitational constant times mass of the attracting body, from Reference 8:

GM_{VENUS} = 0.32486010E6 (km^3/sec^2)

GM_{EARTH} = 0.39860115E6

GM_{MARS} = 0.42828444E5

$GM_{JUPITER}$ = 0.12670772E9

R_I = $R_S + h_I$, Injection radius (km), sum of surface radius $R_{S_{PLANET}}$ and injection altitude h_I, where (see Ref. 8):

$R_{S_{VENUS}}$ = 6052 (km)

$R_{S_{EARTH}}$ = 6378.16

$R_{S_{MARS}}$ = 3393.4

$R_{S_{JUPITER}}$ = 71372

TF Time of flight (Days)

CD Earth to planet communication distance at arrival (km)

VHP Arrival hyperbolic excess velocity

$$V_\infty = \sqrt{V^2 - \frac{2GM}{R}}, \text{(km/sec)},$$

where

V = Heliocentric conic arrival velocity at heliocentric radius R (km).

Arrival Planet Orbit insertion velocity increment ΔV, at periapse, may be computed from V_∞:

$$\Delta V = \sqrt{V_\infty^2 + \frac{GM}{R_P}} - \sqrt{\frac{2GM\,R_A}{R_p(R_A + R_p)}}$$

where R_p and R_A are planetocentric periapse and apoapse radii (km), respectively. Similarly, if specific capture orbit period P(sec) and periapse radius R_p are desired:

$$\Delta V = \sqrt{V^2 + \frac{2GM}{R_p}} - \sqrt{\frac{2GM}{R_p} - \sqrt[3]{\left(\frac{2GM\pi}{P}\right)^2}}$$

B-PLANE A plane normal to the incoming V_∞ - vector and passing through the center of planet.

T-AXIS Axis in B-plane, parallel to ecliptic (Earth mean orbital) plane (see Figure 1).

DLA Geocentric declination (vs. mean Earth equator of launch date) of the departure V_∞ - vector. May impose launch constraints. (deg)

ZAL Angle between departure V_∞ vector and Sun-Earth vector. Equivalent to Earth-probe-Sun angle, several days out. (deg)

INC Heliocentric inclination of transfer trajectory with mean ecliptic (Earth orbital) plane of launch date. (deg)

ZAP Angle between arrival V_∞ vector and the arrival planet-to-Sun vector. Equivalent to planet-probe-Sun angle at far encounter; for subsolar impact would be equal to 180° (deg).

ETS Angle in arrival B-plane, measured from T-axis, clockwise, to projection of Sun-to-planet vector. Equivalent to solar occultation region center-line. (deg)

LVI Planetocentric latitude of vertical impact vs arrival planet equator. Note that Venusian north is below ecliptic, while Mars' and Jupiter's is above. Equivalent to declination of the incoming asymptote (i.e., the negative of incoming V_∞ vector) in planetary equator system.

ZAE Angle between arrival V_∞ vector and the planet-to-Earth vector. Equivalent to planet-probe-Earth angle at far encounter. (Deg.)

ETE Angle in arrival B-plane, measured from T-axis, clockwise, to projection of Earth-to-planet vector. Equivalent to Earth occultation region centerline. (deg)

THA Angle in arrival B-plane, from T-axis, clockwise, to major axis of error dispersion ellipse (0 – 180 deg).

SG1 Semi-major axis magnitude of B-plane dispersion ellipse, resulting from a spherically distributed V_∞ velocity vector error of 0.1 m/sec on departure asymptote (km).

SG2 Semi-minor axis of above dispersion eclipse (km).

SG3 Arrival time dispersion, normal to B-plane, for above error model (sec).

C. DESCRIPTION OF PLANETARY POSITIONAL DATA

1. General

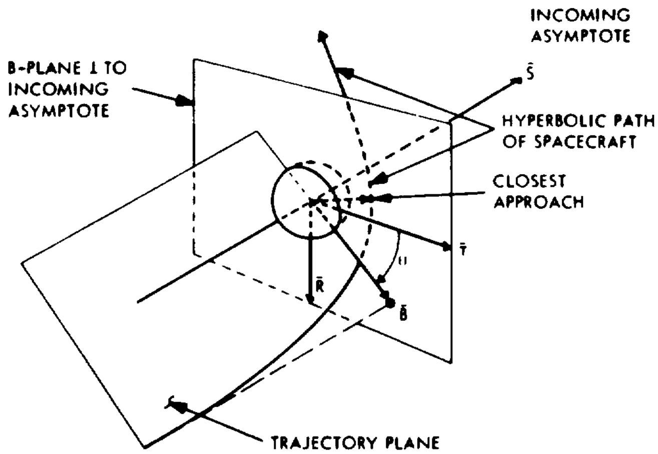
The data represent planetary geometry-related information plotted versus calendar arrival date at the target planet. Each set of seven plots represents the annual time history of 19 parameters, and may be used for flyby and orbiter missions.

2. Description of Curve Labels

P	Target planet, equivalent to probe approaching or in orbit about target planet.
E	Earth
S	Sun
CA	Cone Angle, i.e., Sun-probe-object (Earth or Canopus, etc.) angle. (See Figure 2.)
KA	Clock Angle, i.e., angle between projections of the Probe-Canopus and probe-object vectors into the plane normal to the sun-line (for which CA = 90°). (See Figure 2.)
RISEXX	Rise time (GMT) of planet through 6° horizon mask at DSN Station No. XX. (e.g., XX = 14 = GOLDSTONE, 43 = CANBERRA, 63 = MADRID.)
SETXX	Set time (GMT) of planet through 6° horizon mask at DSN Station No. XX.
YR/M/D	Year, Month, Date.

3. Description of Plots

Plot	Y-axis label	
a)	DECLIN	Geocentric Earth equatorial declination of planet (P), planetocentric planetary equatorial declination of Earth (E) and Sun (S). Note that Venusian north is below ecliptic.
b)	EC.LON	Heliocentric ecliptic longitude of planet.
c)	CA,KA	Cone (ECA) and Clock (EKA) angle of Earth and cone angle of Canopus (CCA) as seen from a Sun-Canopus oriented spacecraft near target planet, P (see Figure 2).
d)	DISTANCE	Sun-Planet distance (SP) and Earth-Planet communication distance (EP) in mill. km.
e)	SUN-EARTH-PLANET	Sun-Earth-Planet angle (SEP), indicating times of superior (SEP $\simeq$ 0) and inferior (SEP $\simeq$ 180°) conjunction; SEP > 5° is a communications constraint.
f)	STATION RISE/SET	Rise and Set times (GMT) of planet at 3 DSN Stations on Earth, 6° mask.



$\bar{B}$ = TARGET PARAMETER
θ = ORIENTATION OF $\bar{B}$
$\bar{S}$ = INCOMING ASYMPTOTE
$\bar{T}$ = PARALLEL TO ECLIPTIC PLANE AND ⊥ TO $\bar{S}$
$\bar{R}$ = $\bar{S} \times \bar{T}$

Figure 1. Definition of B-Plane

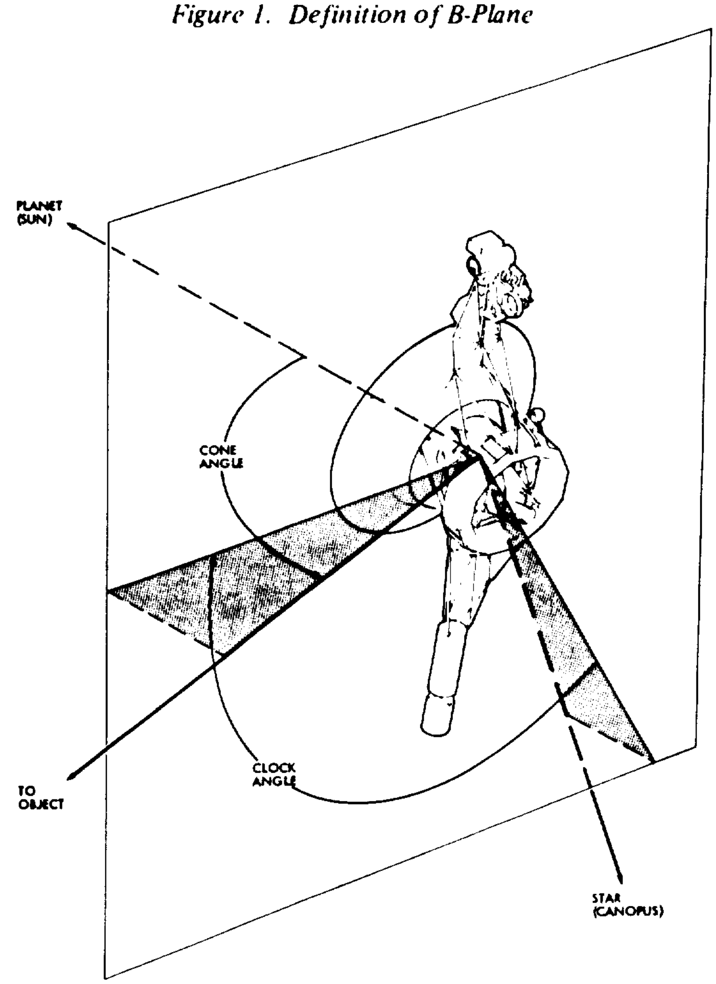


Figure 2. Definition of Cone and Clock Angle

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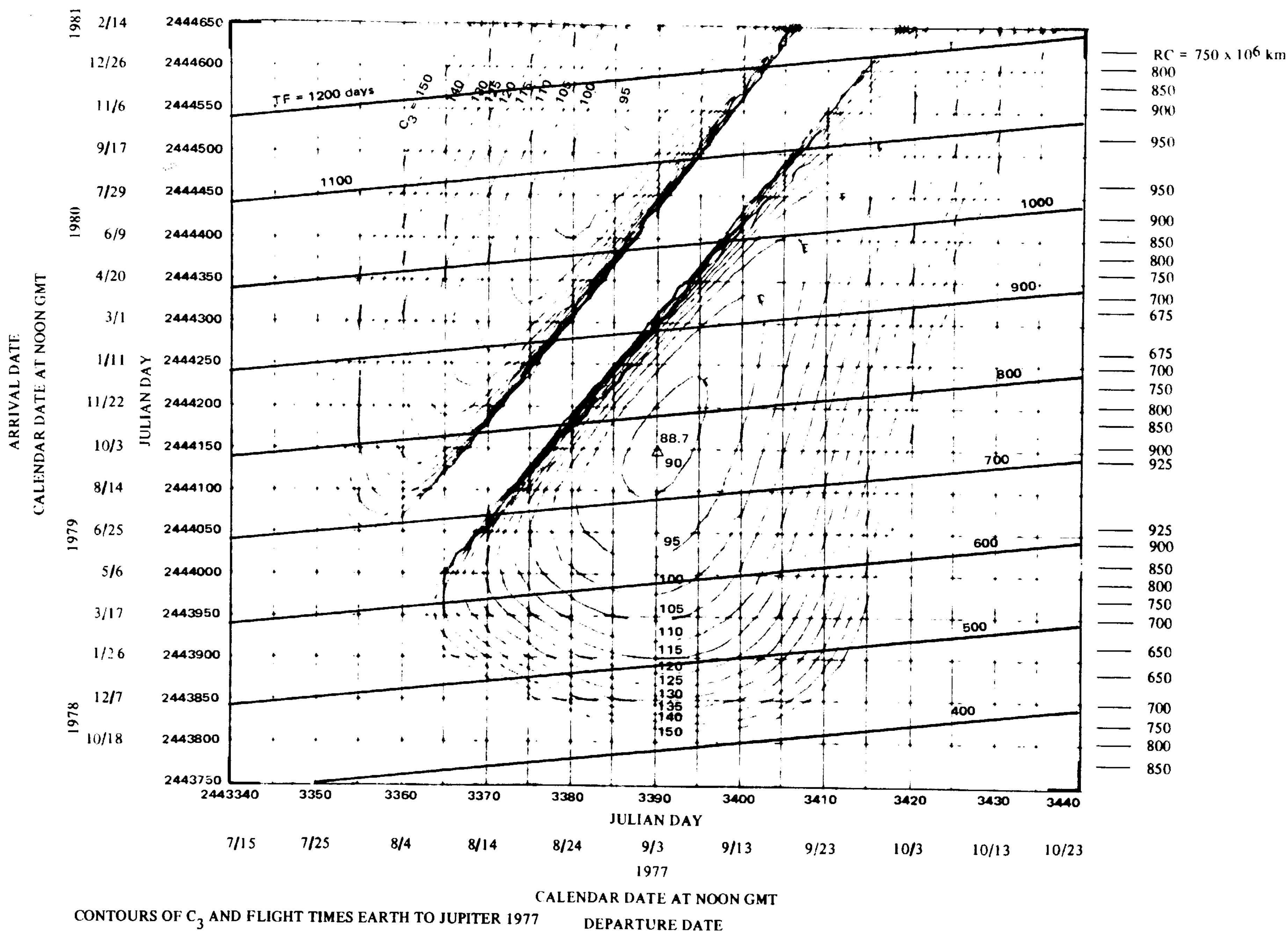

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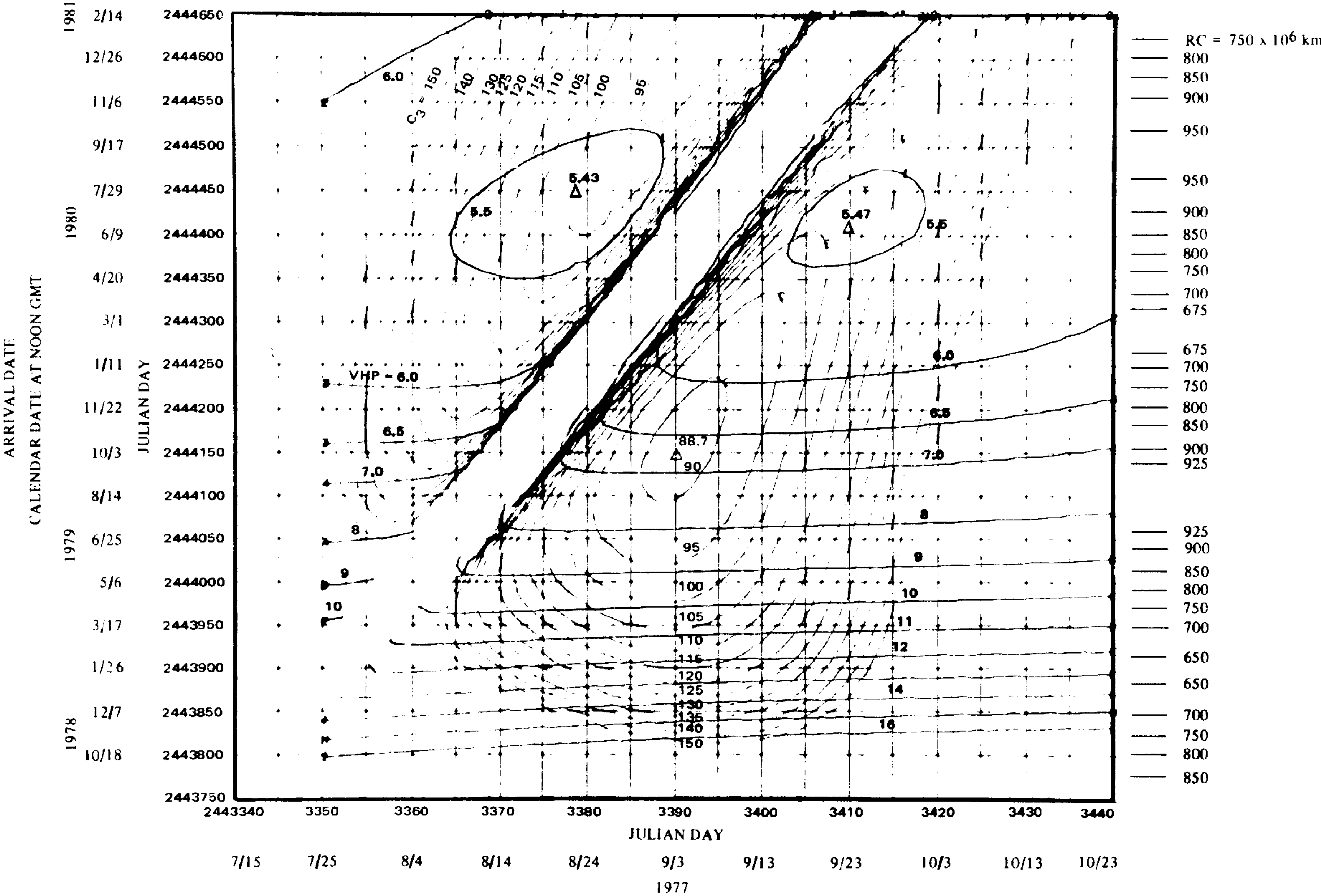

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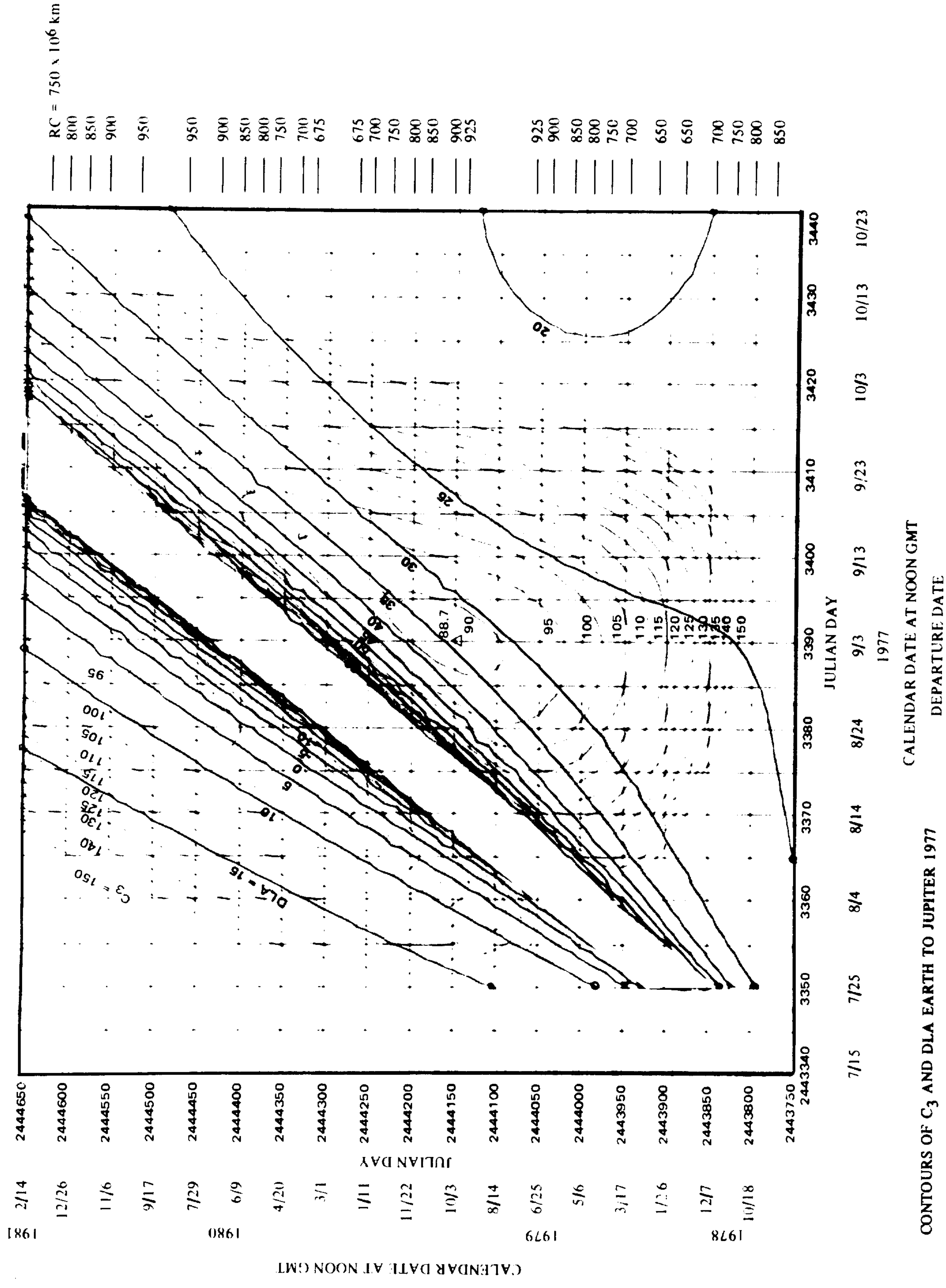

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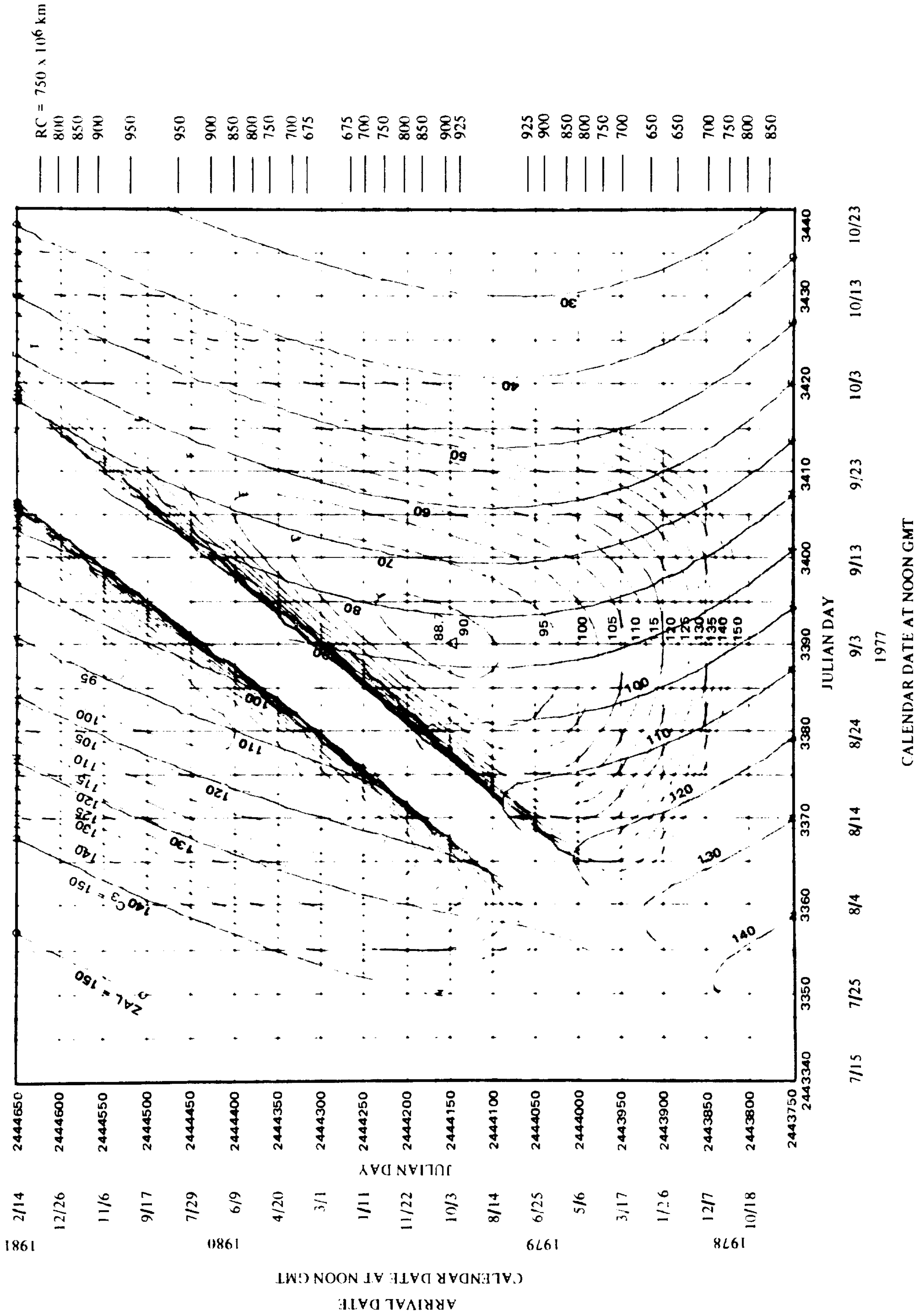

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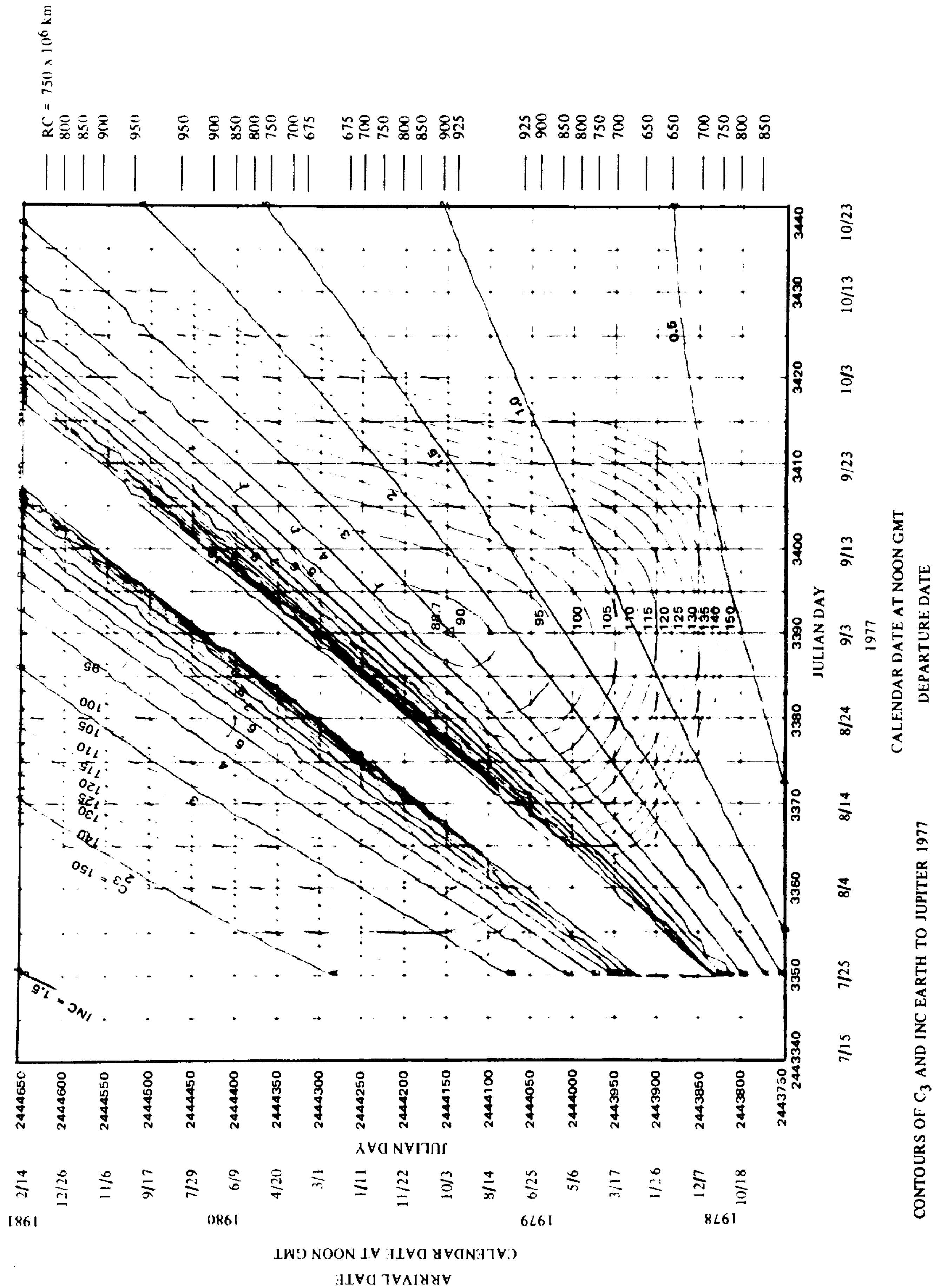

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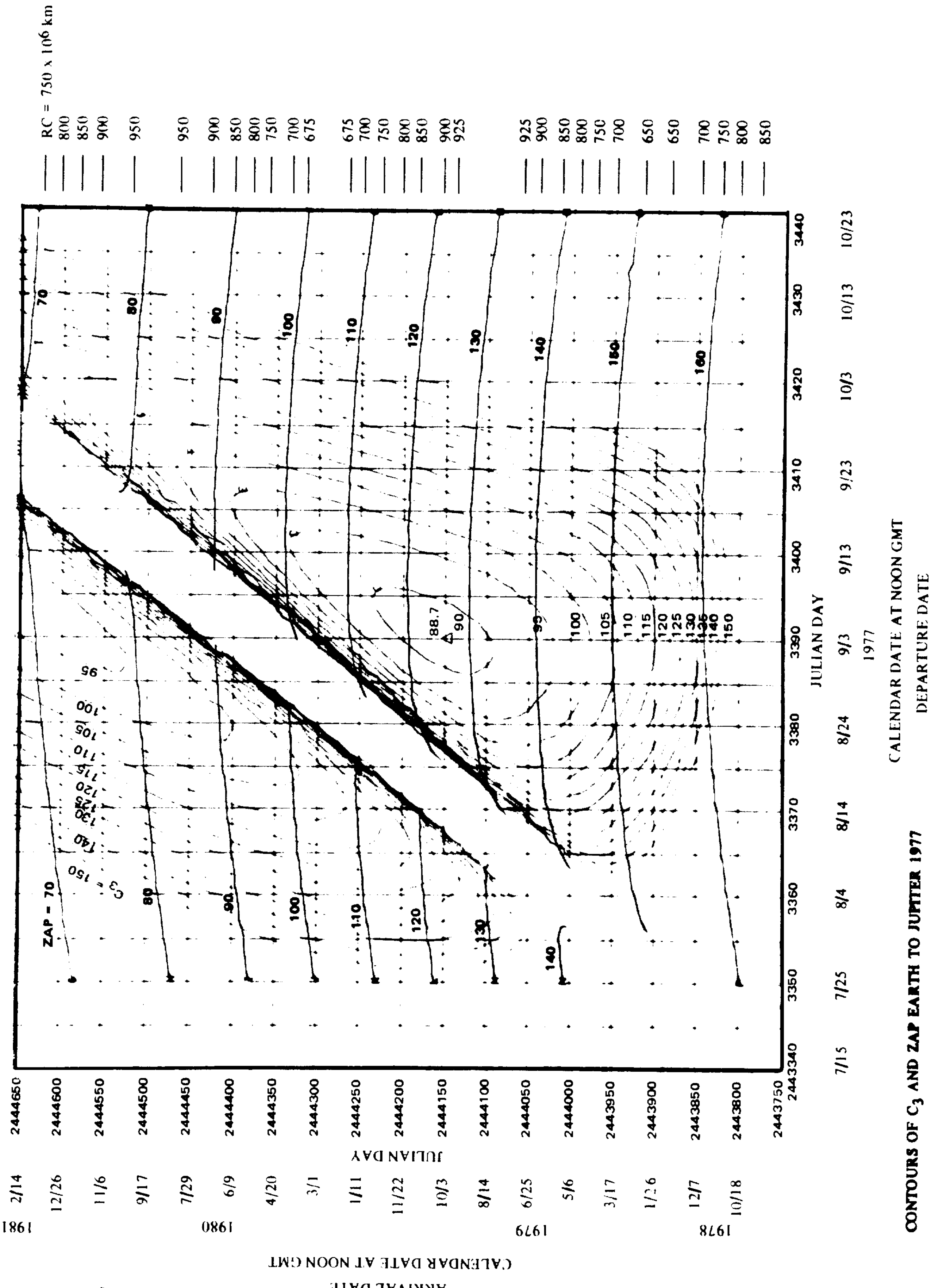

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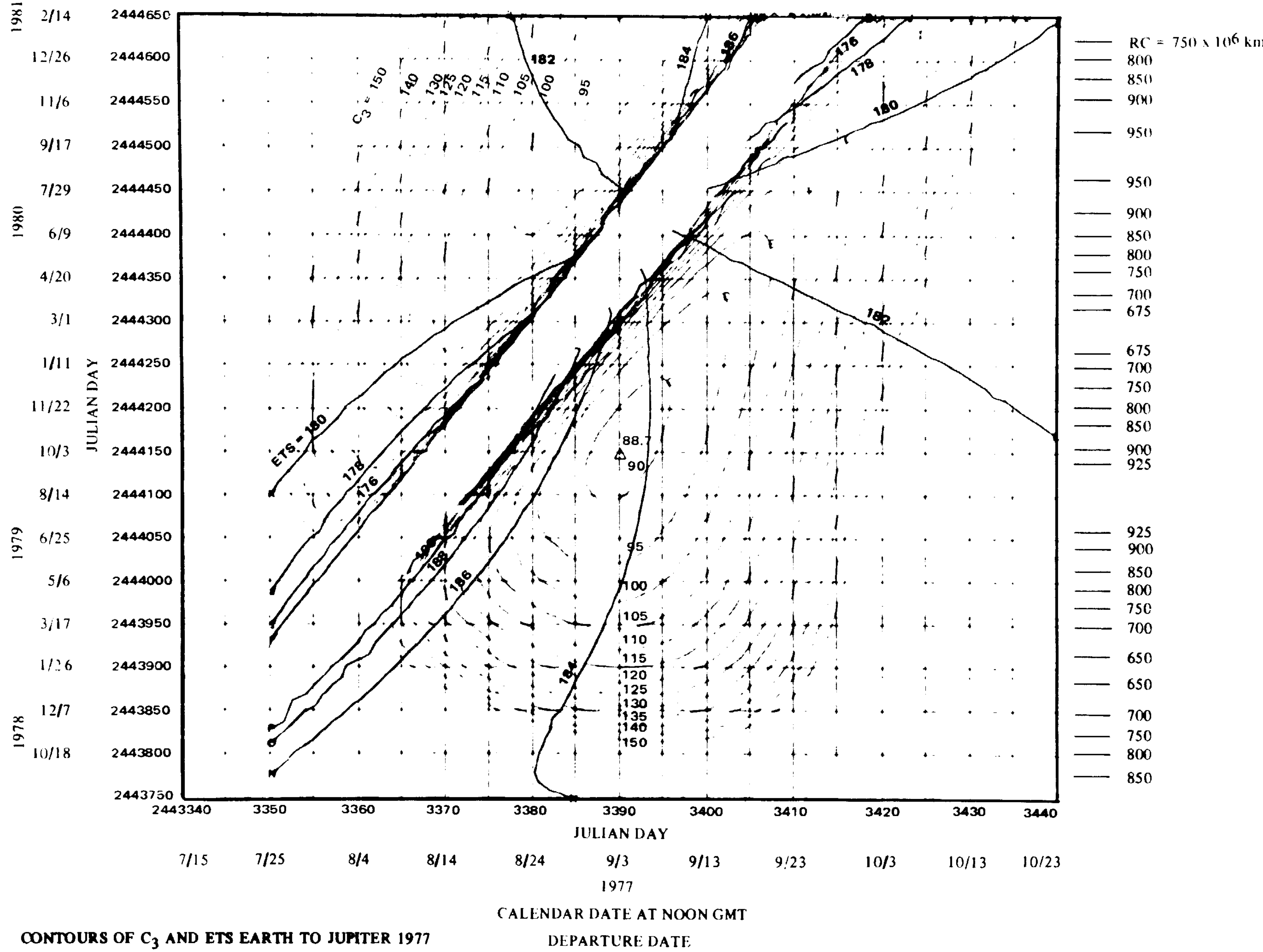

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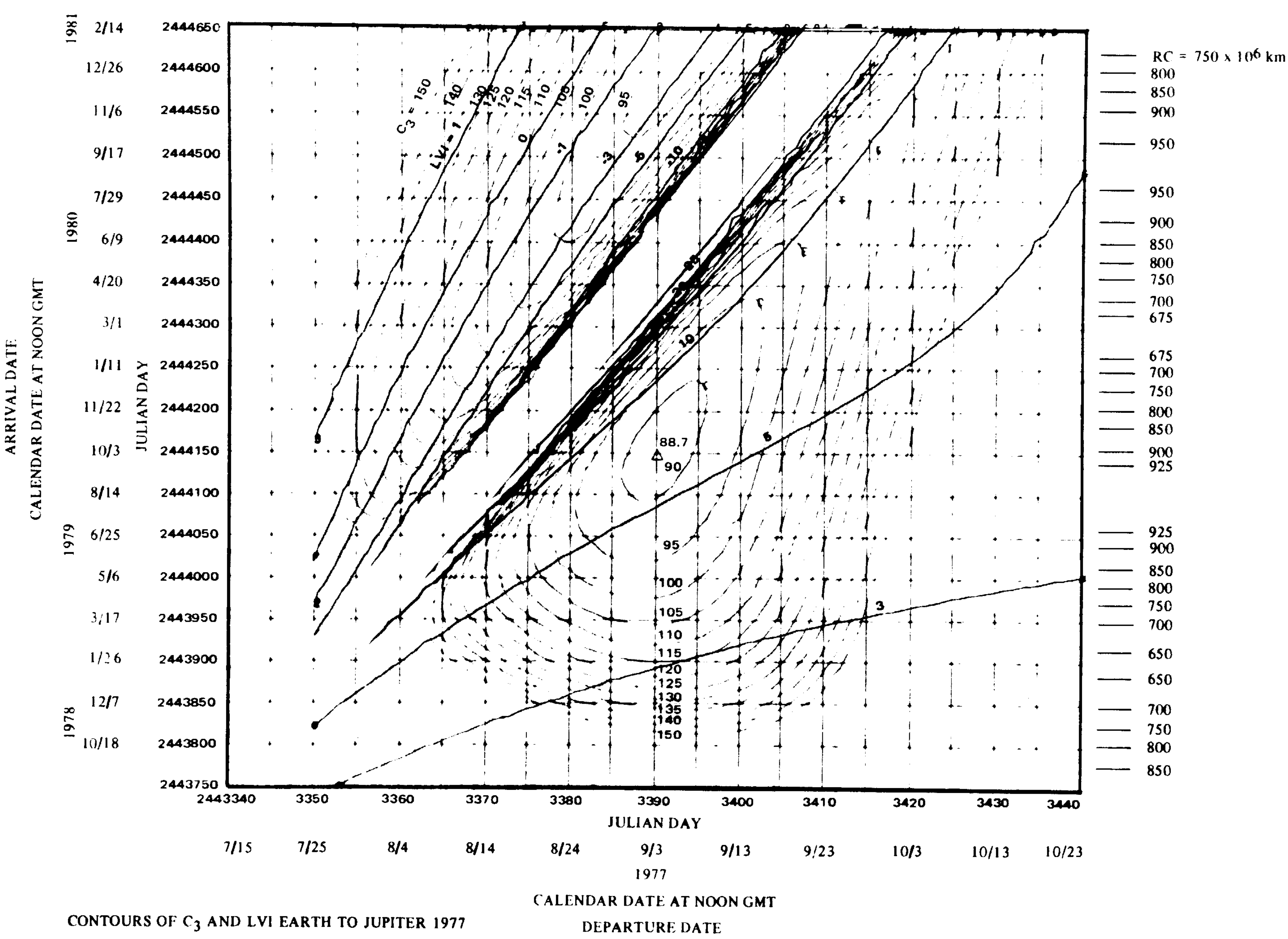

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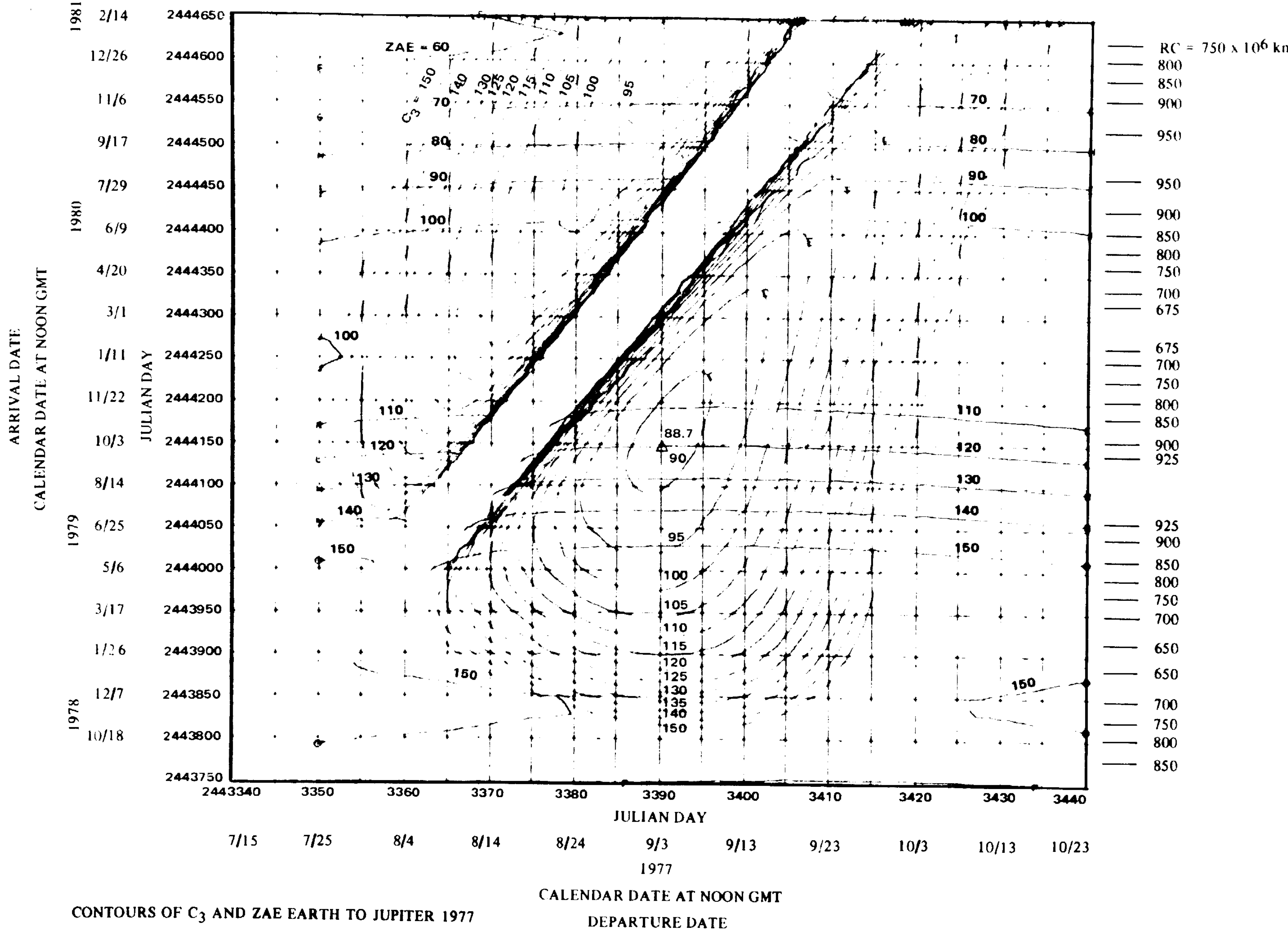

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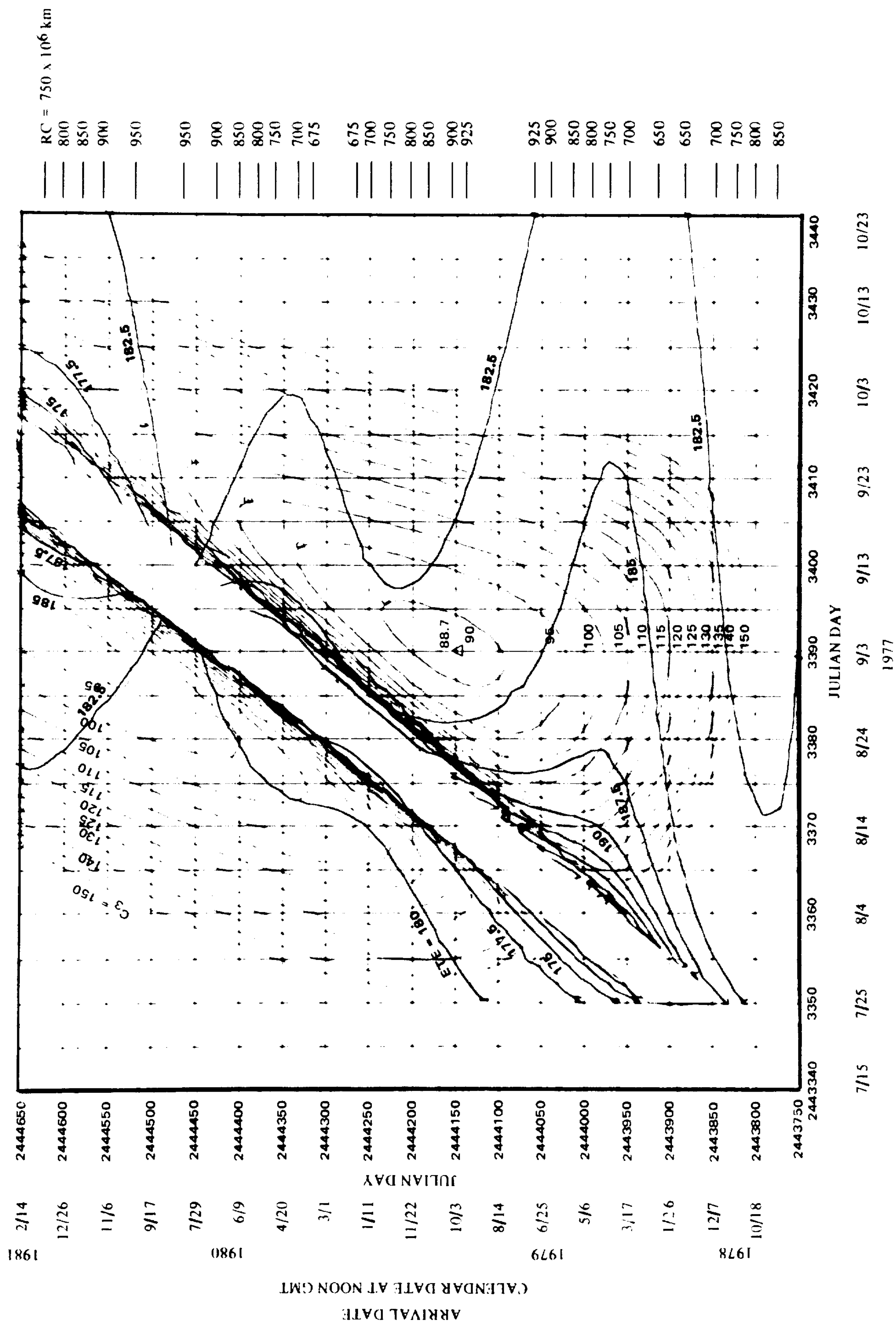

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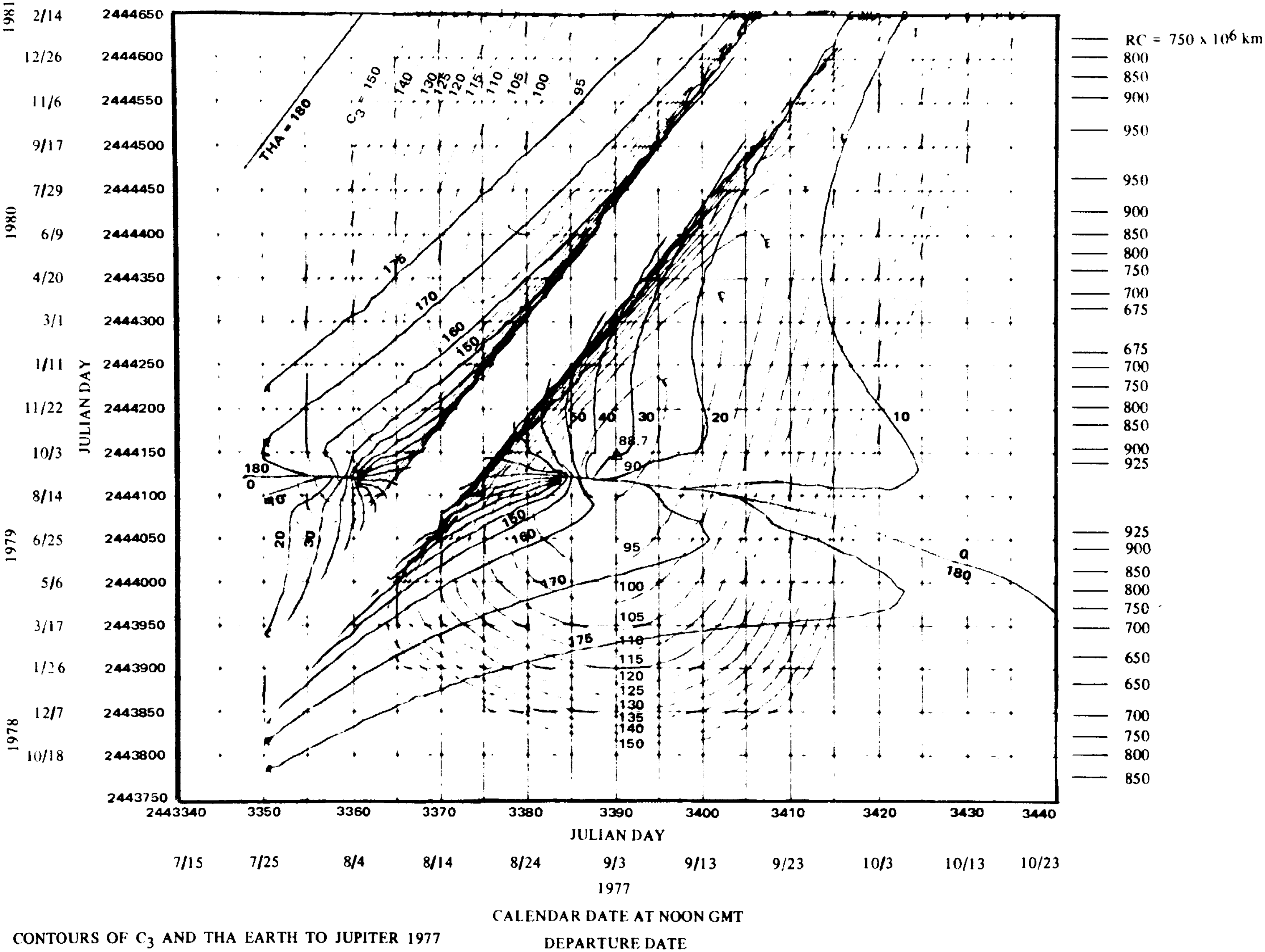

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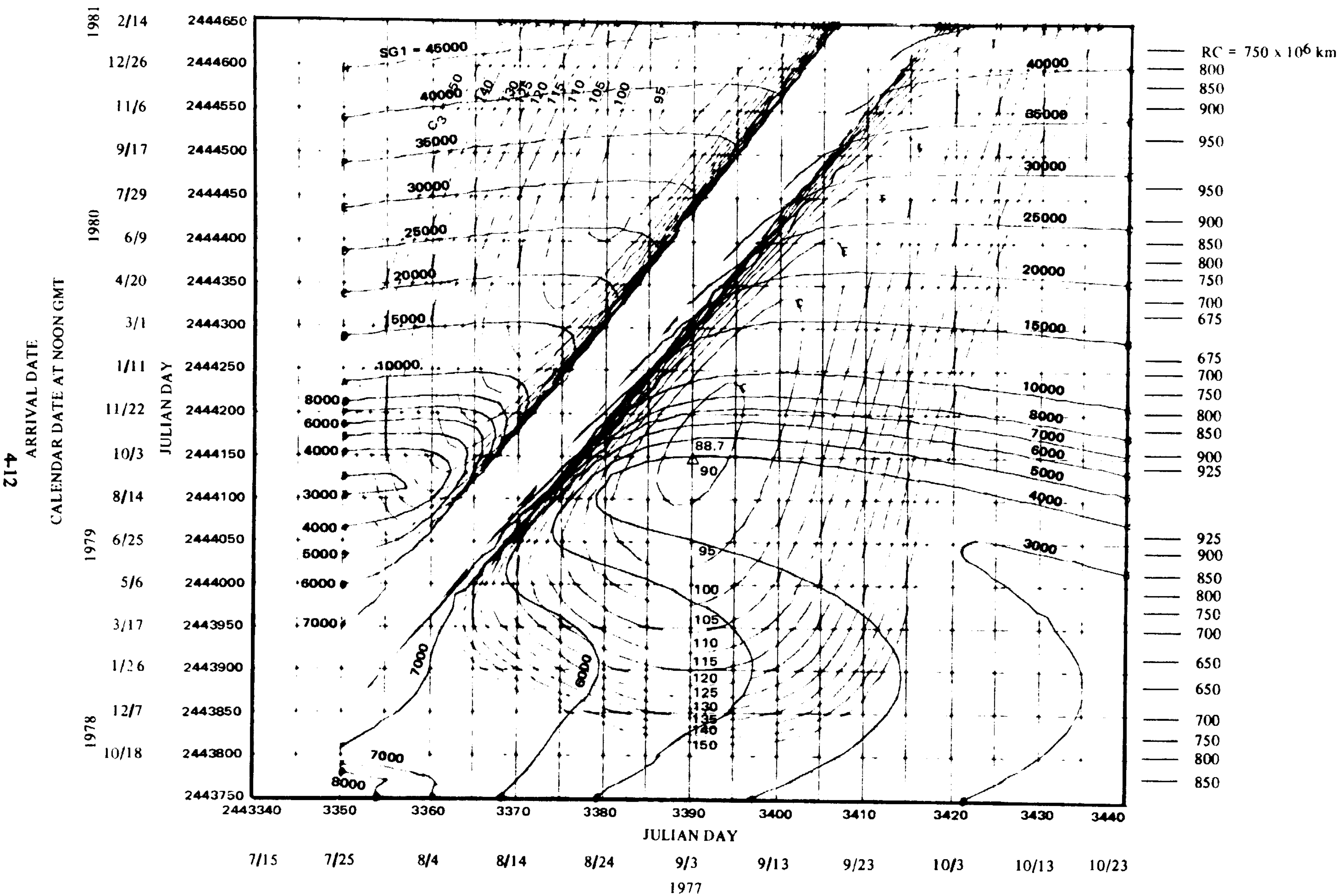

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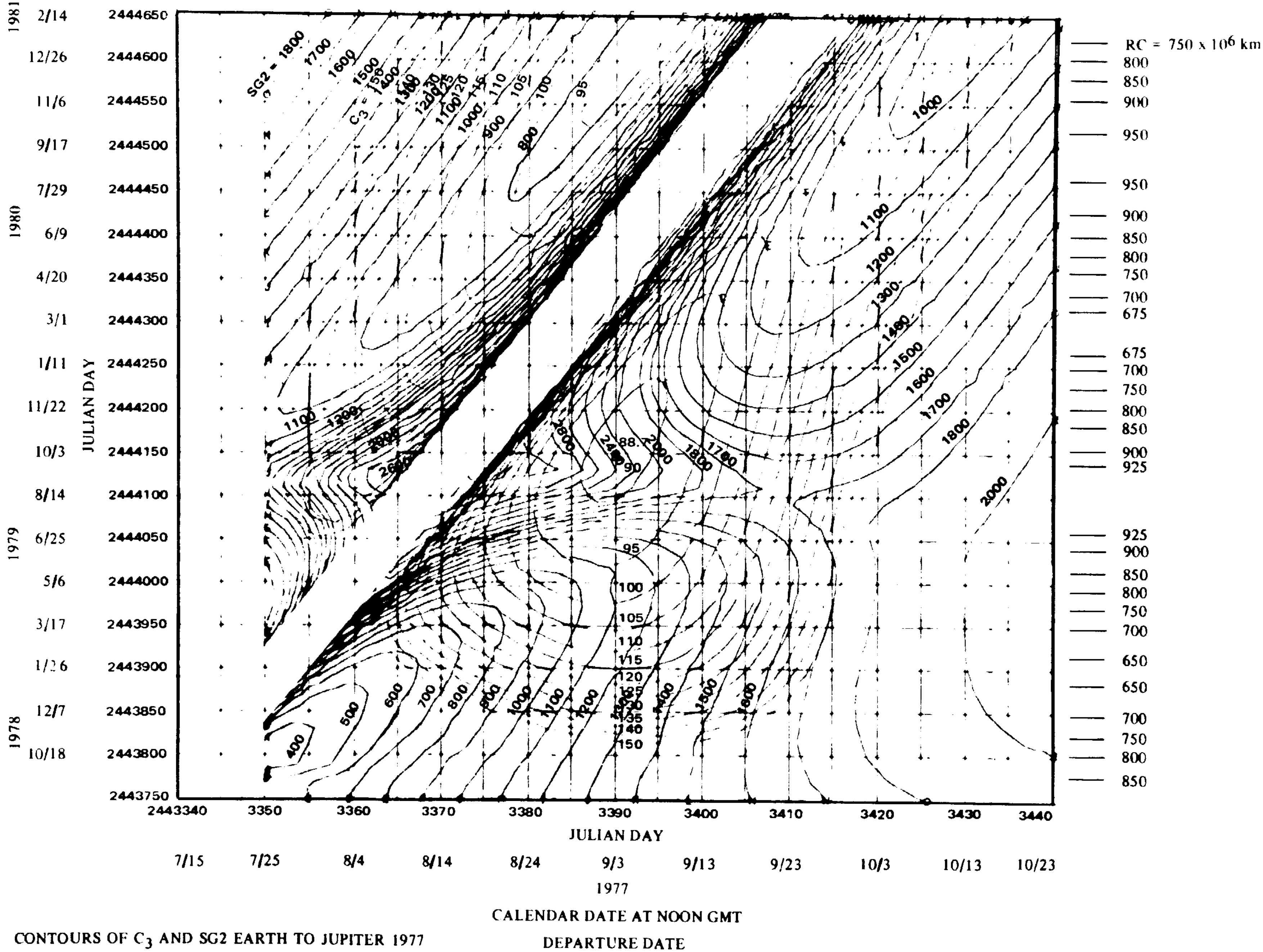

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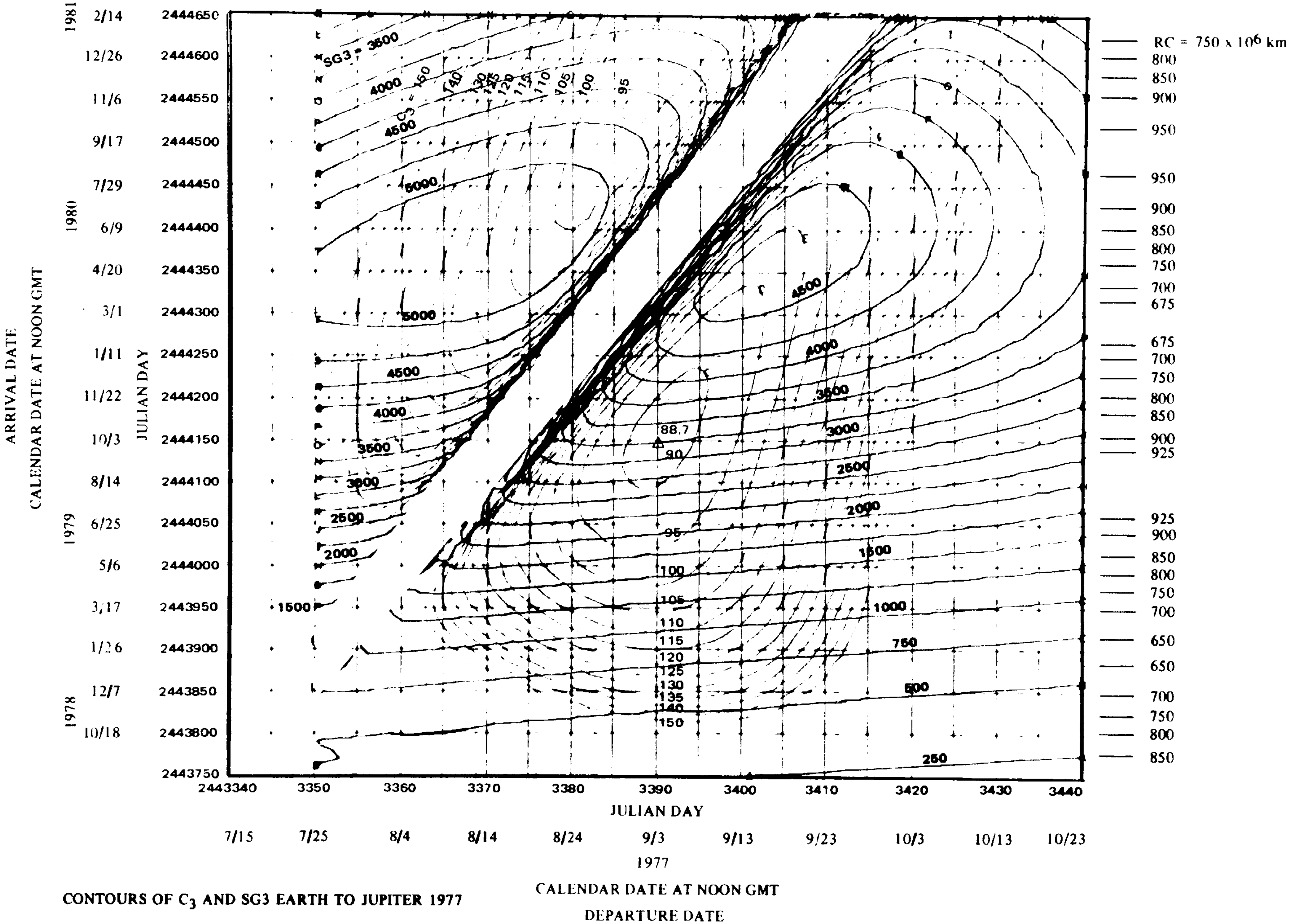

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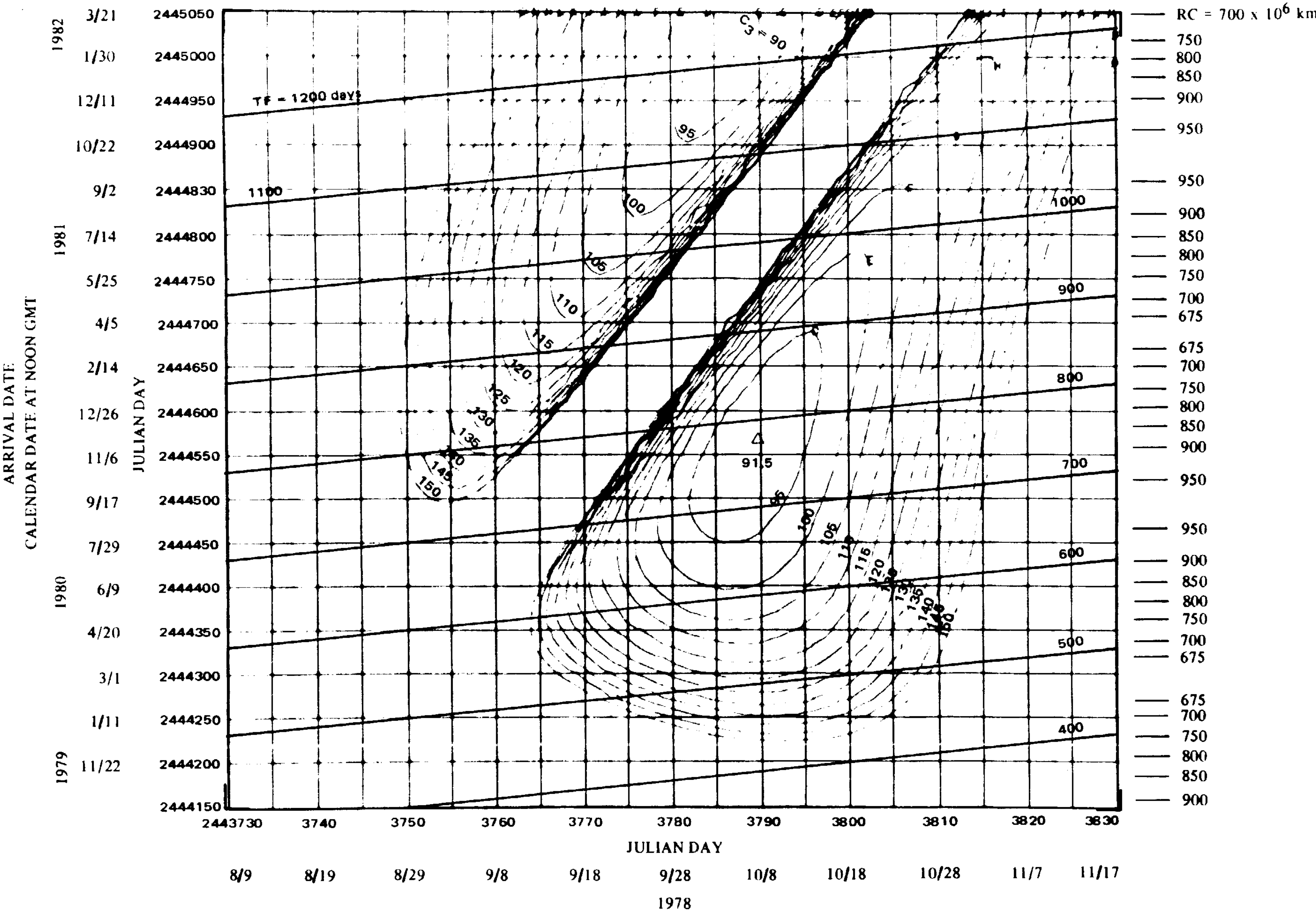

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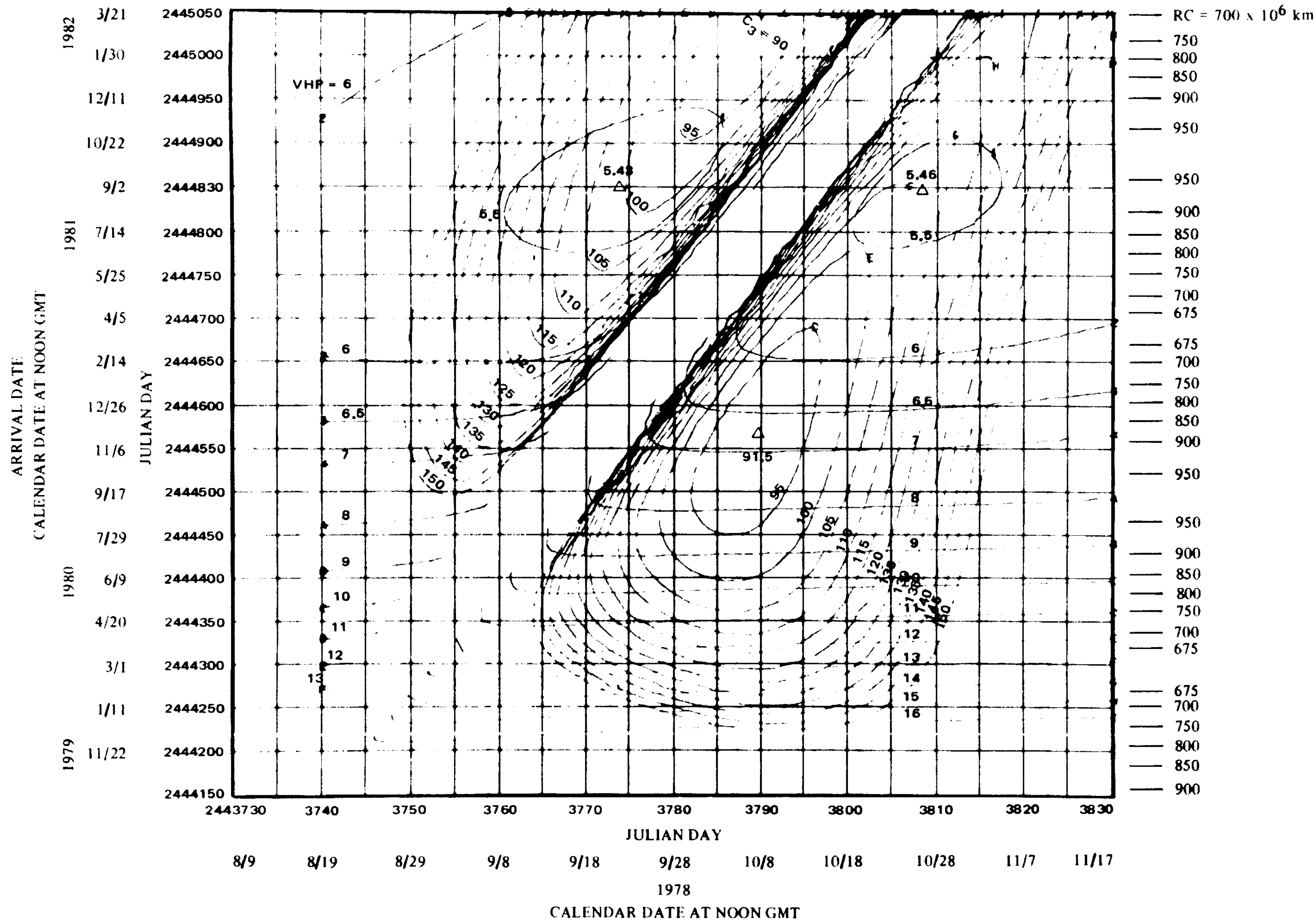

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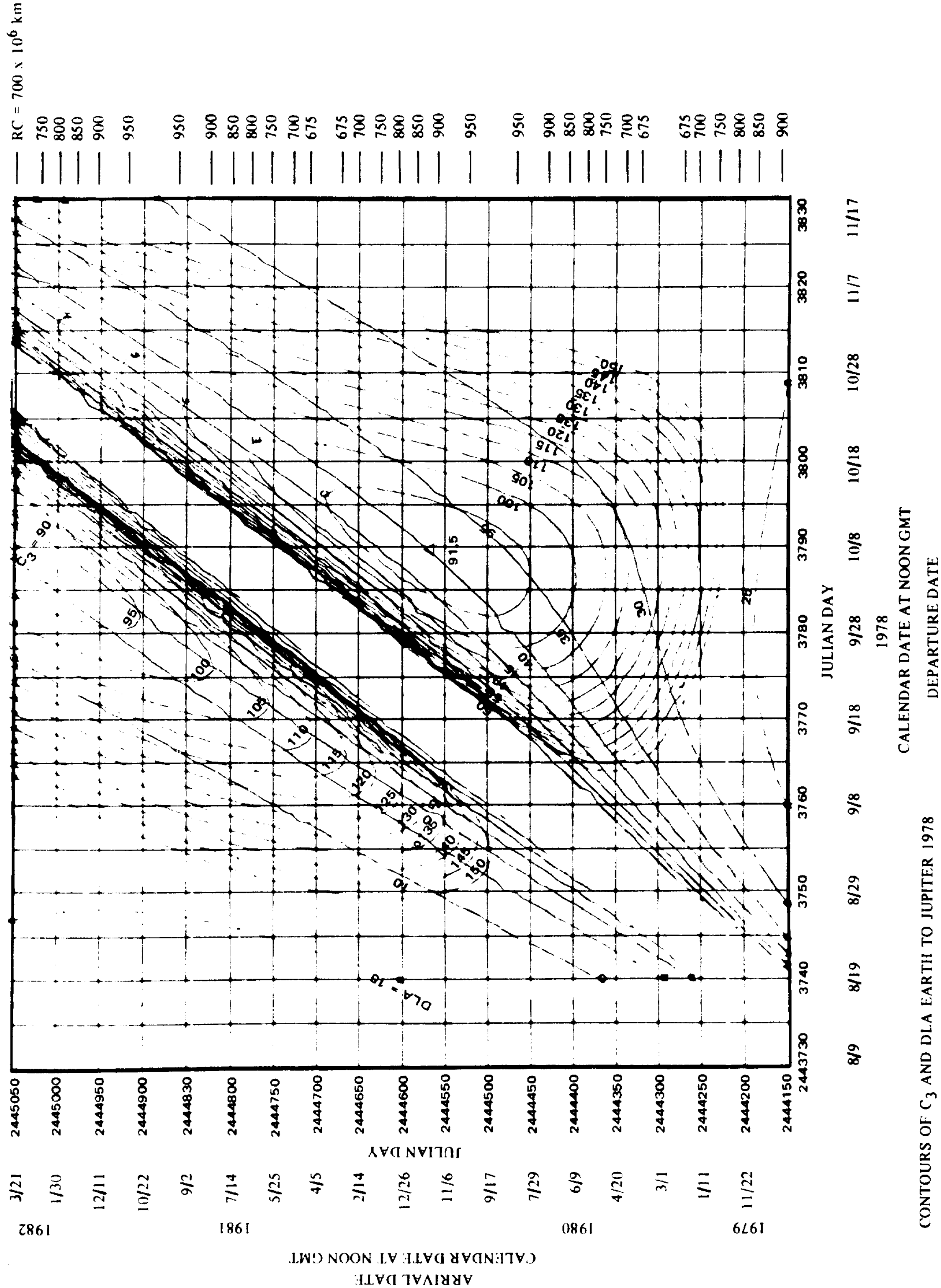

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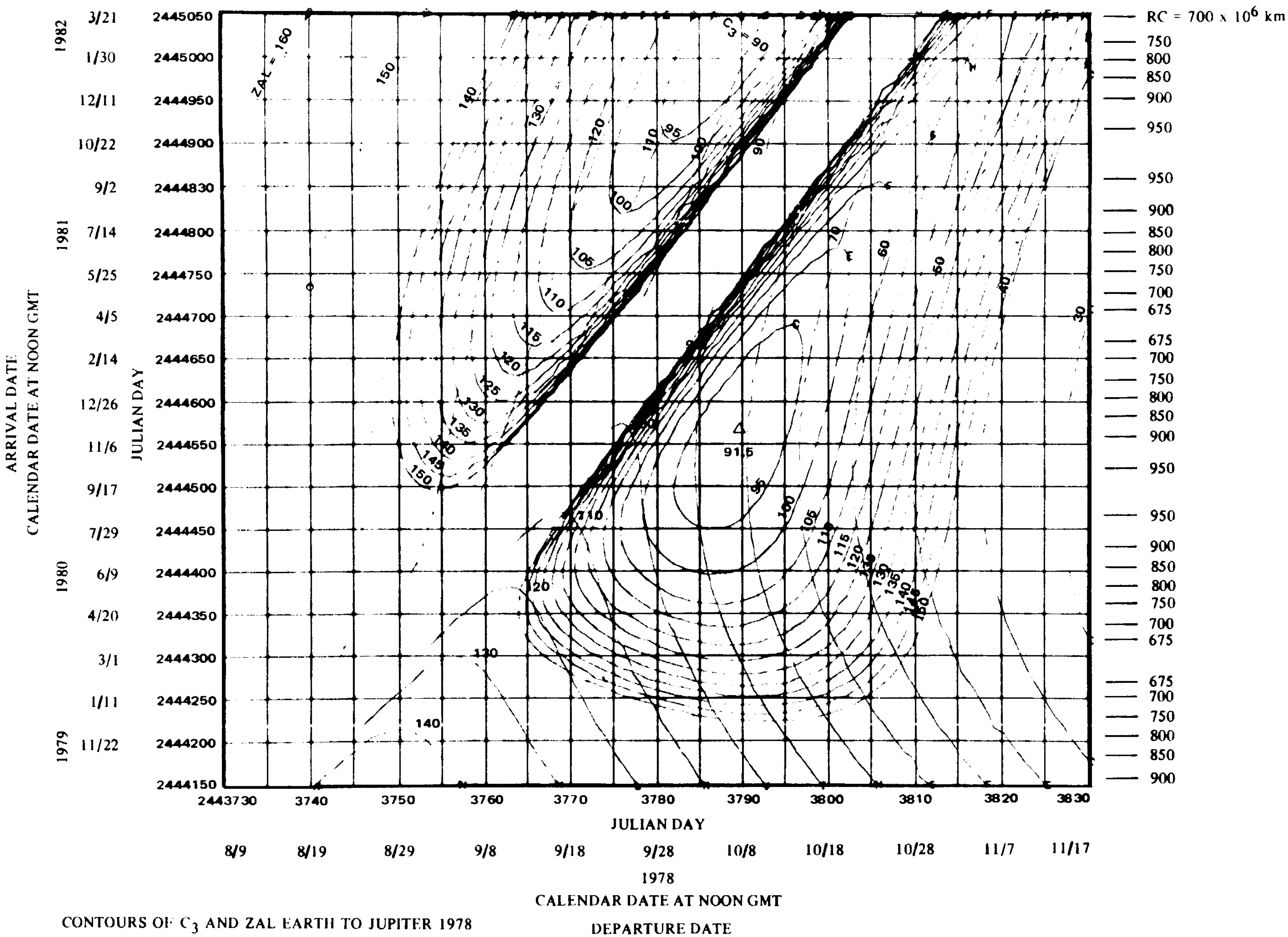

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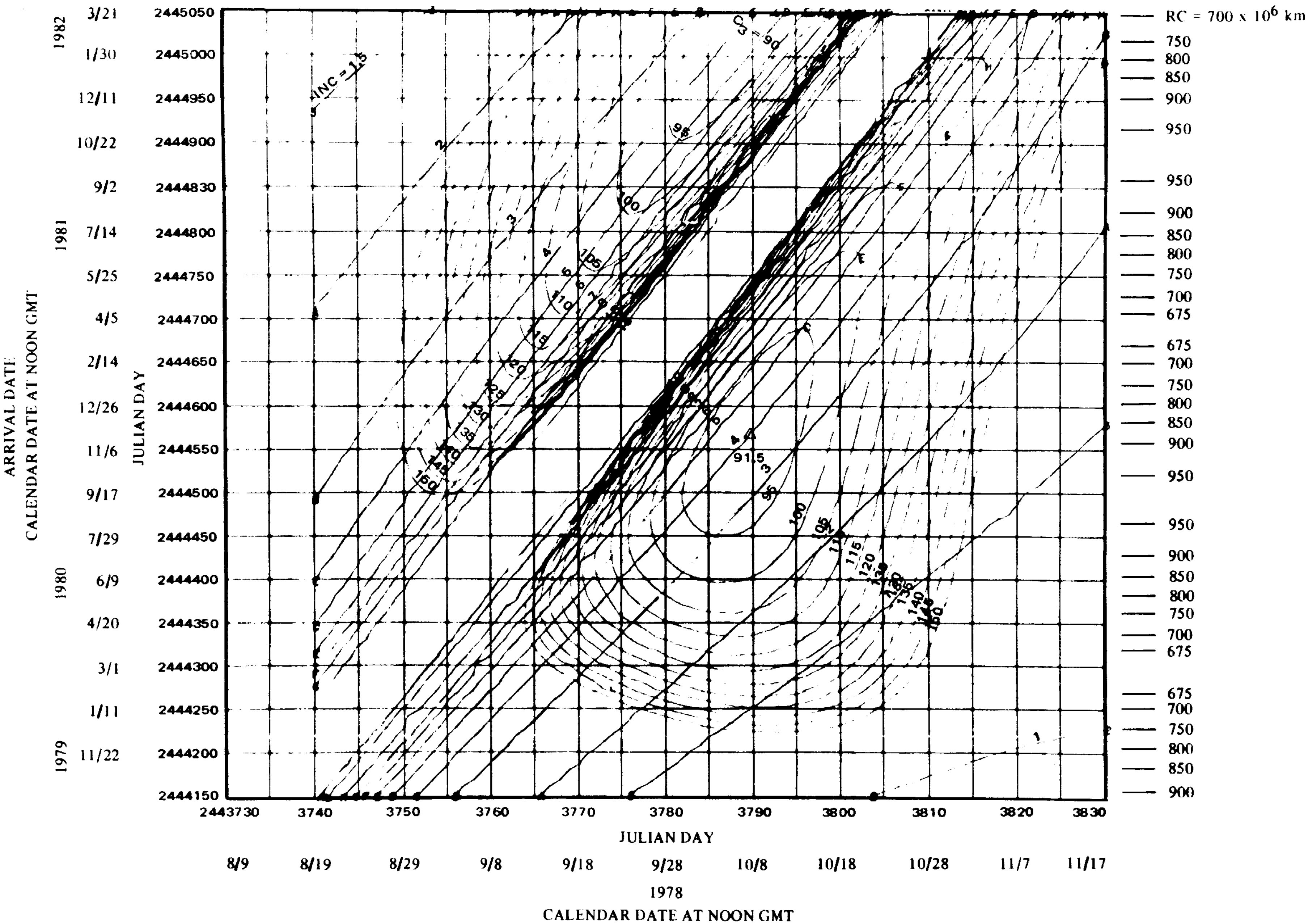

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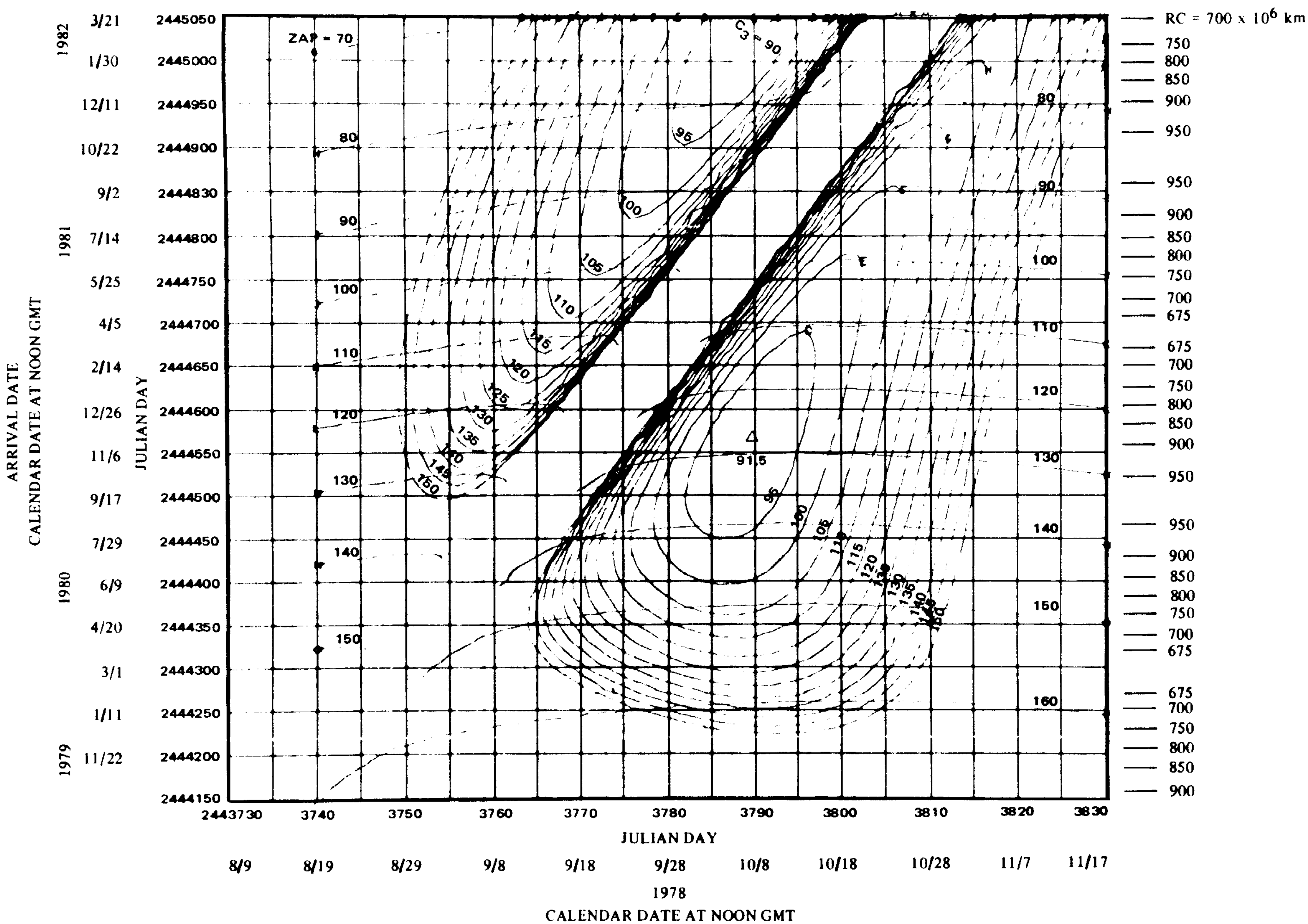

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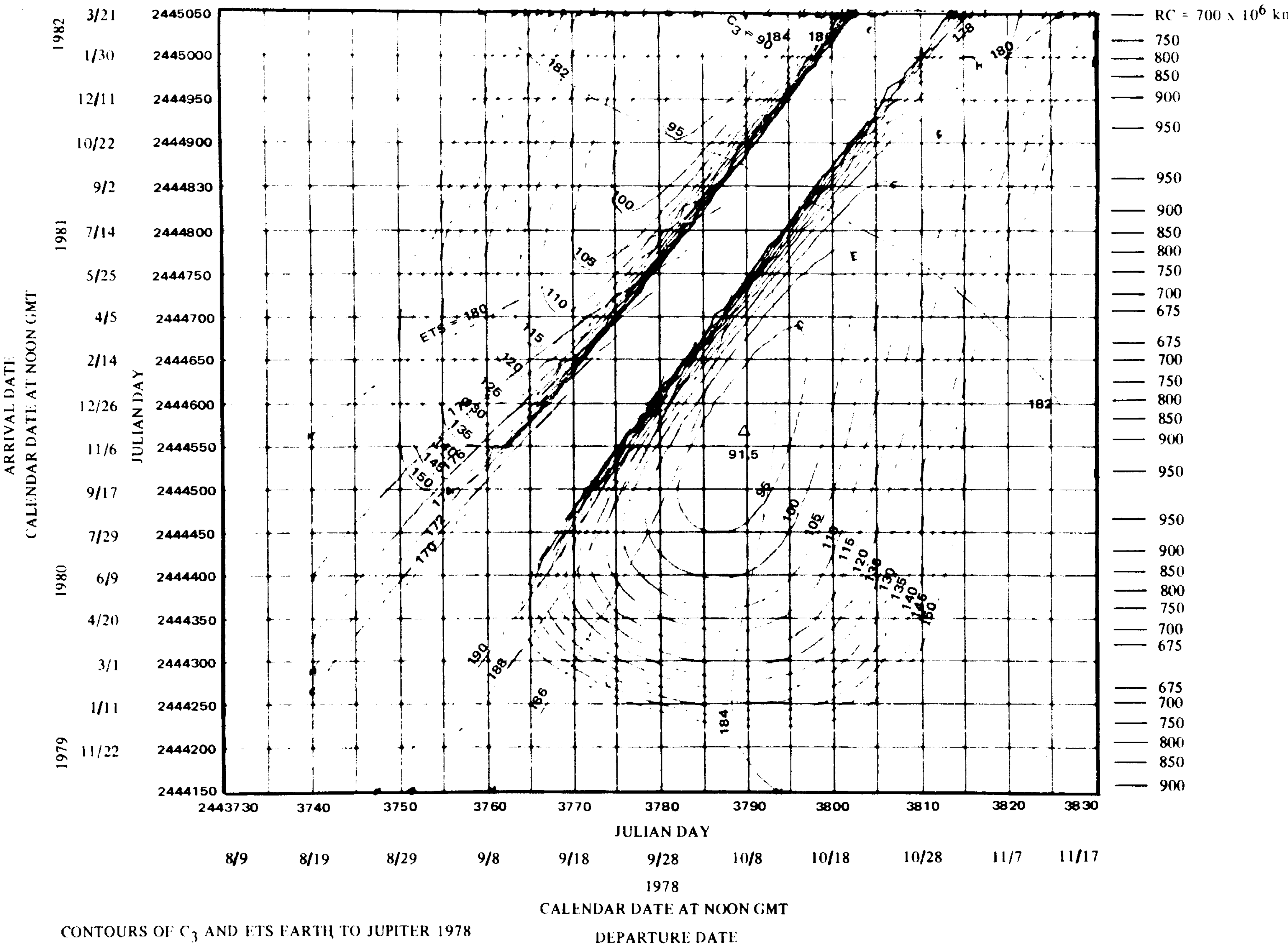

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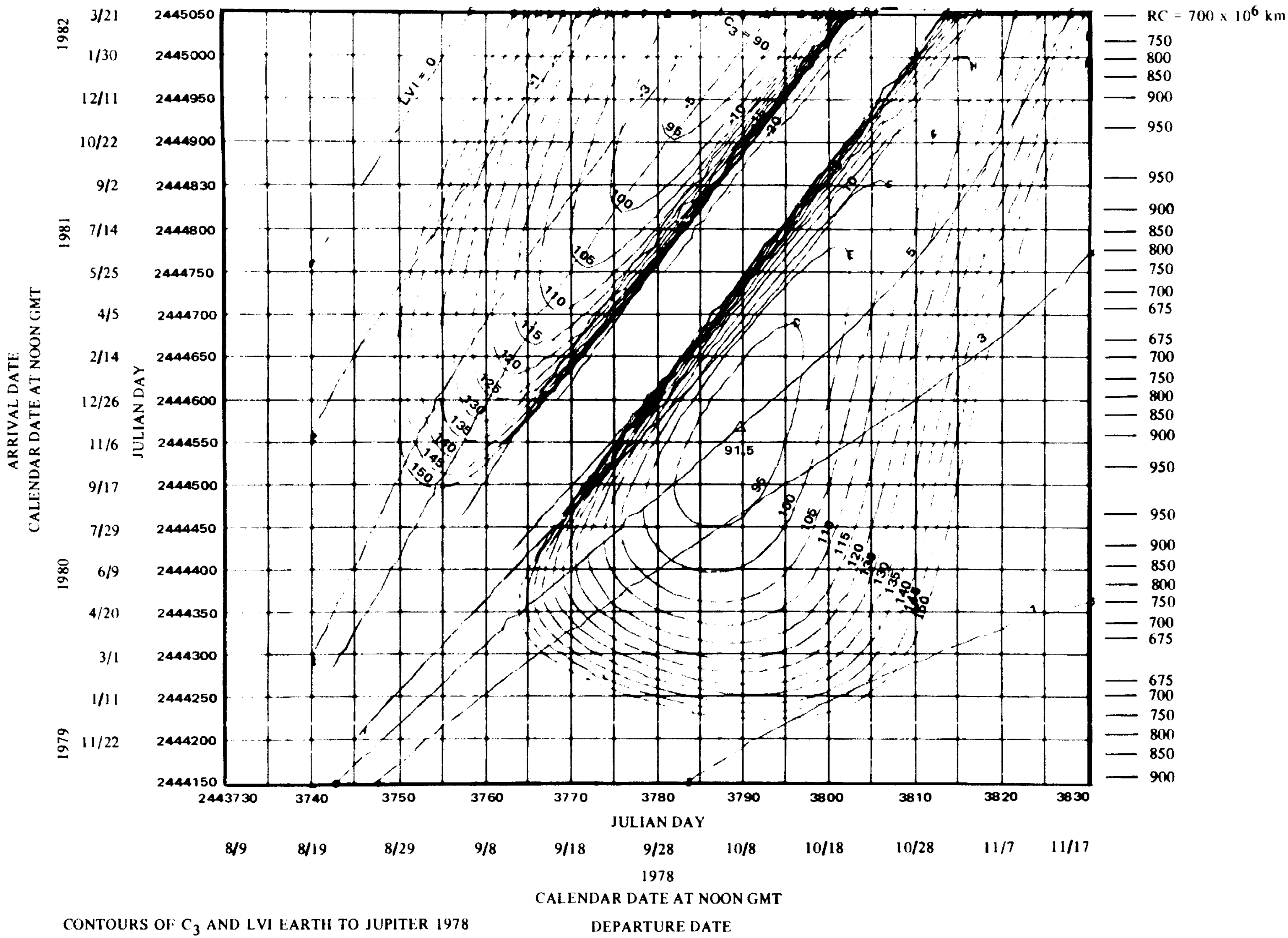

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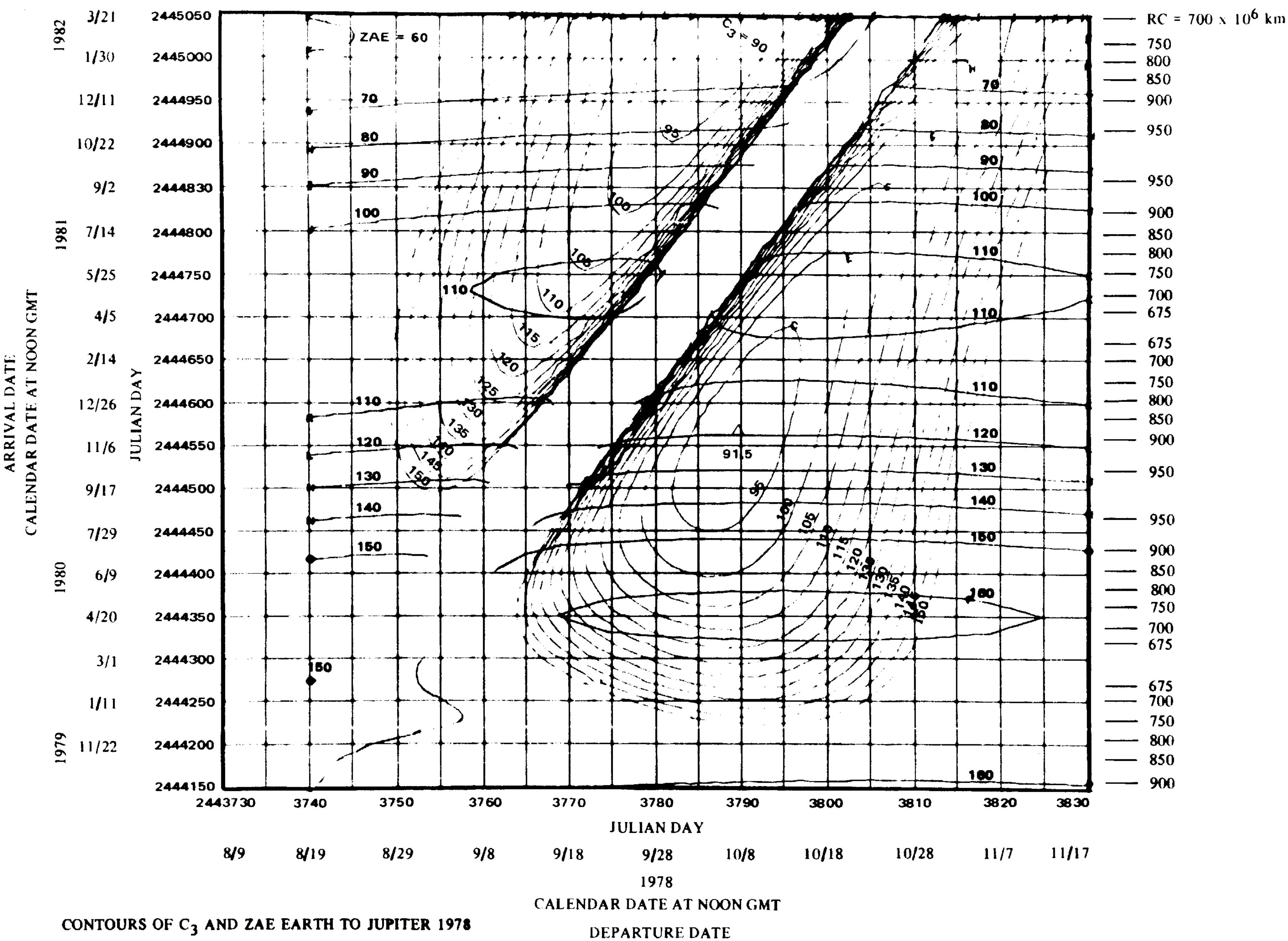

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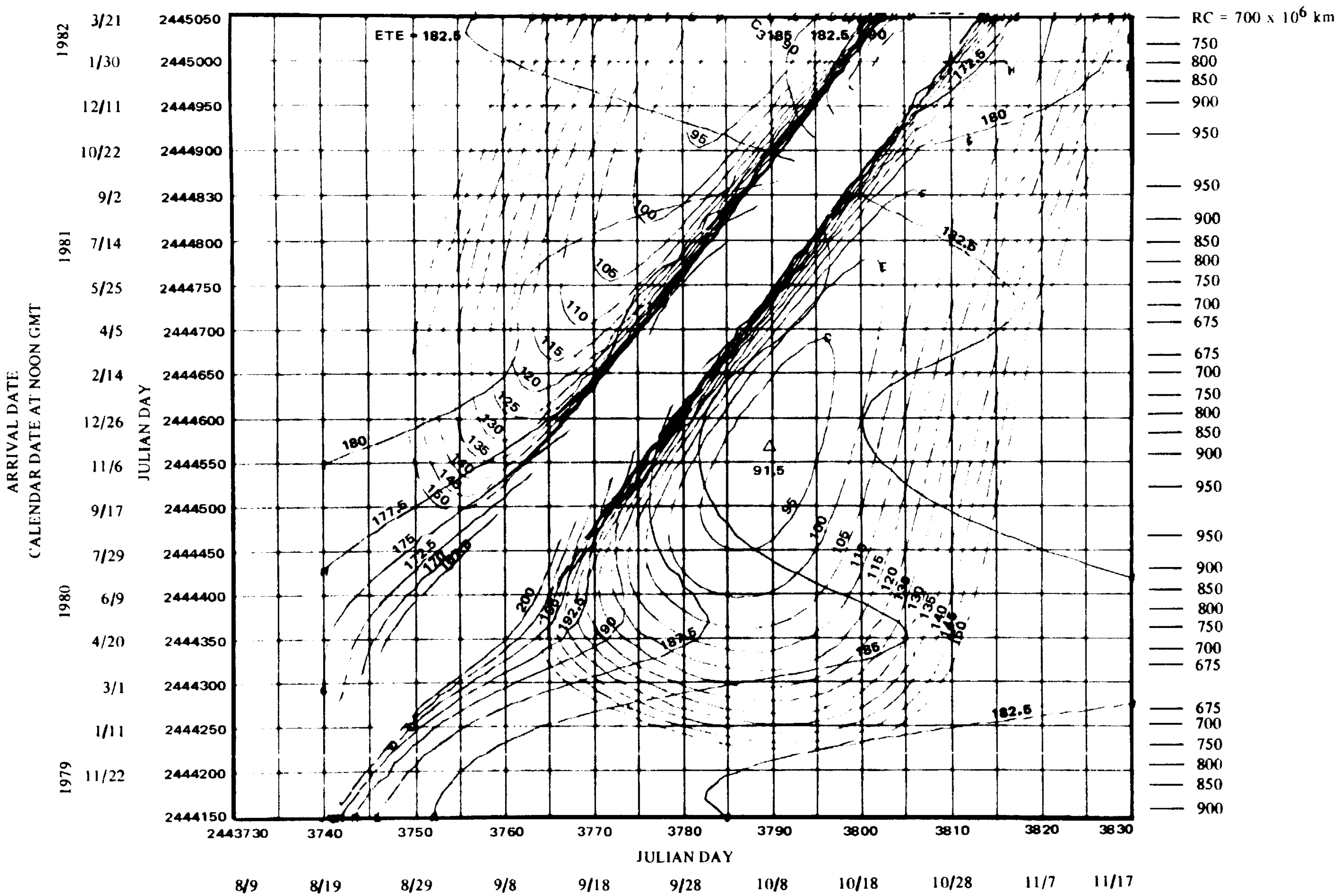

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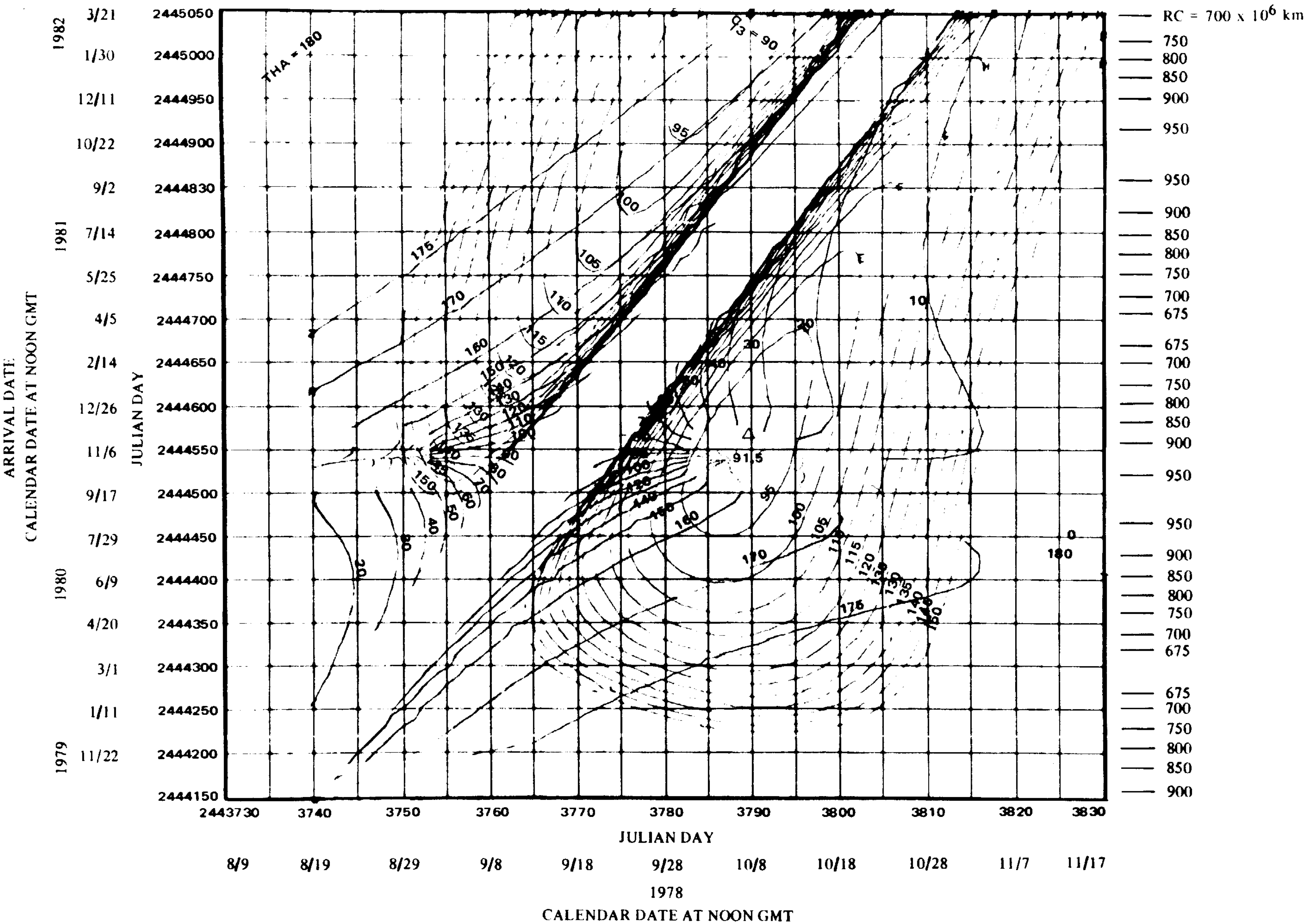

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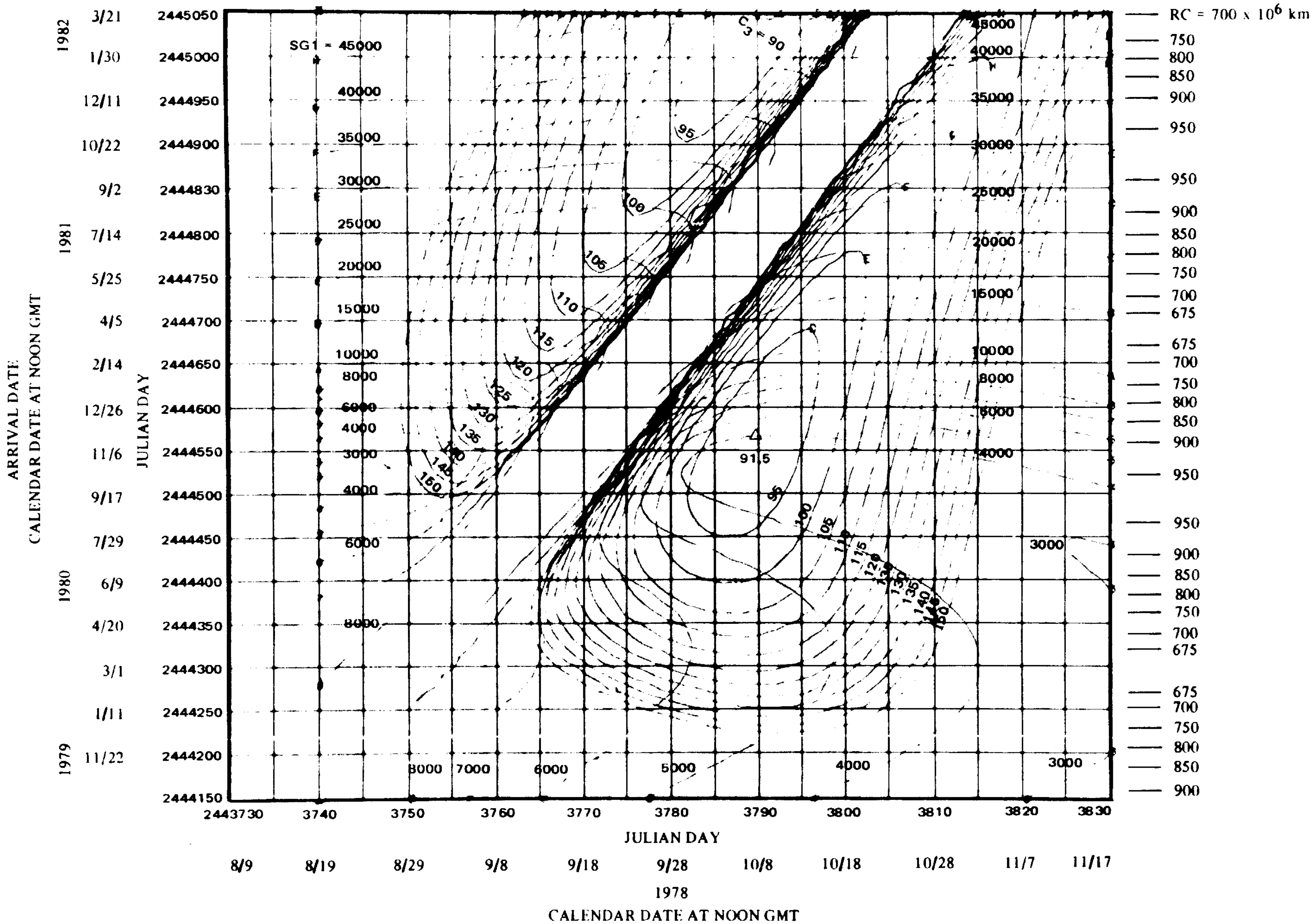

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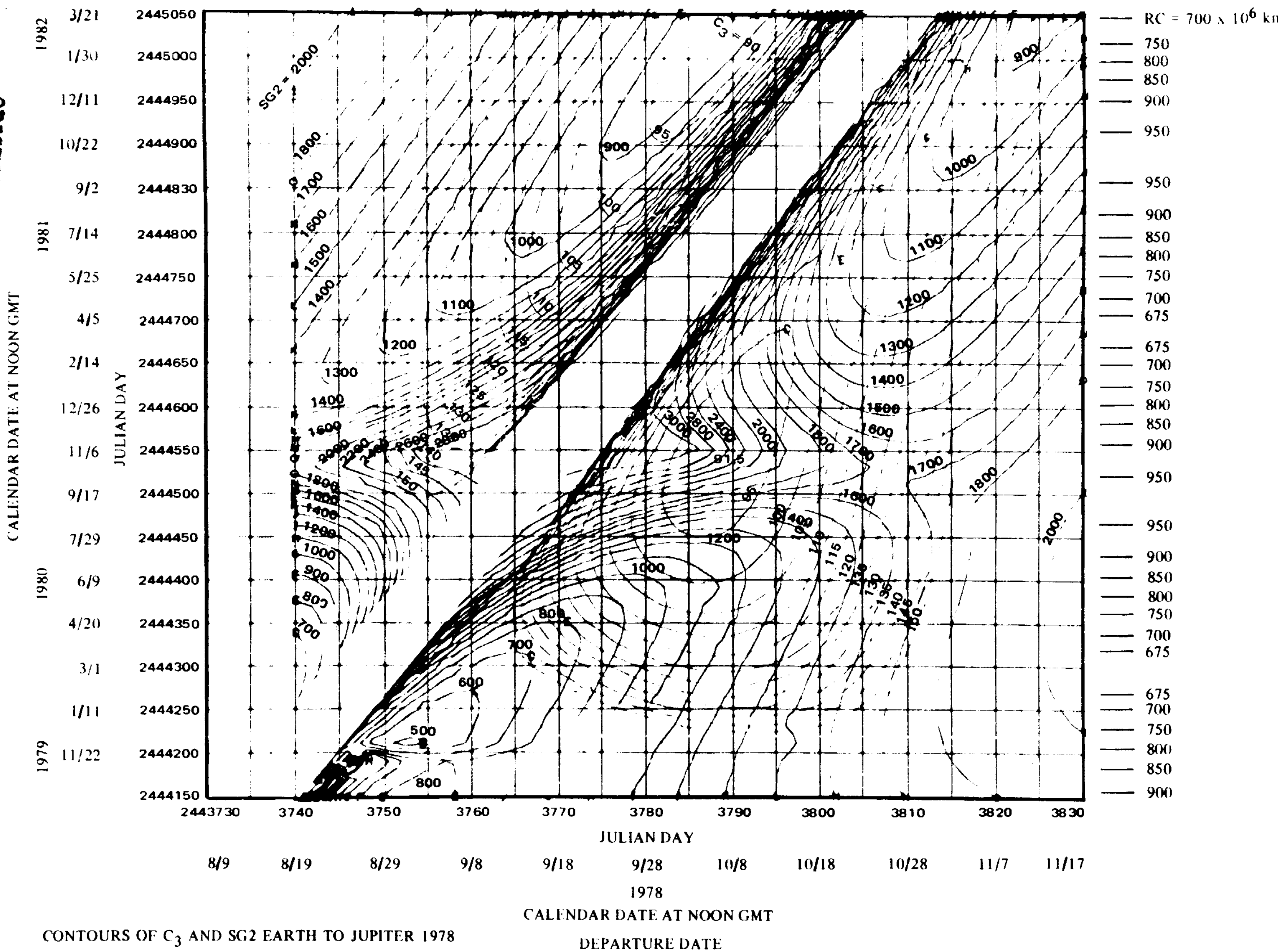

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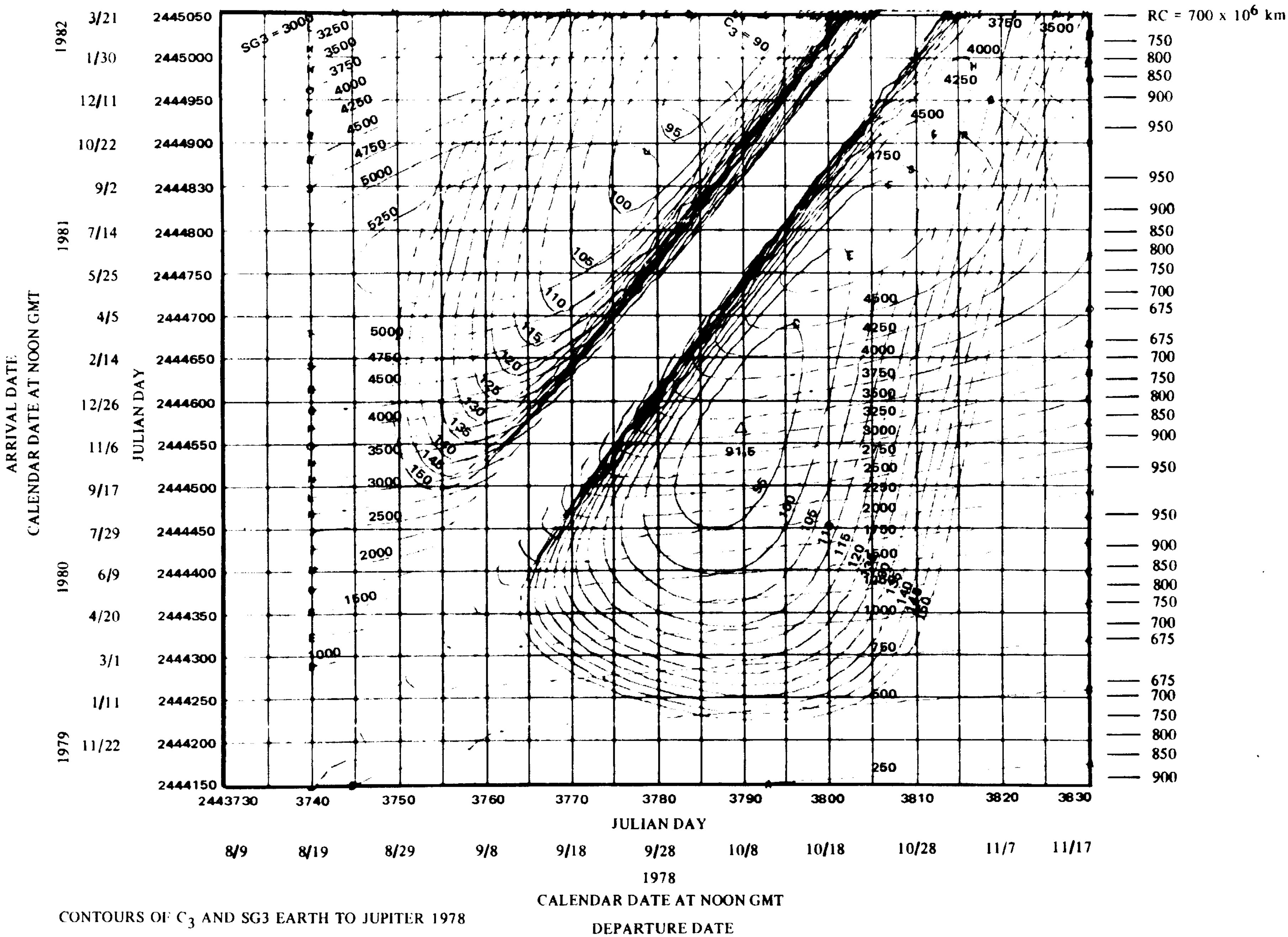

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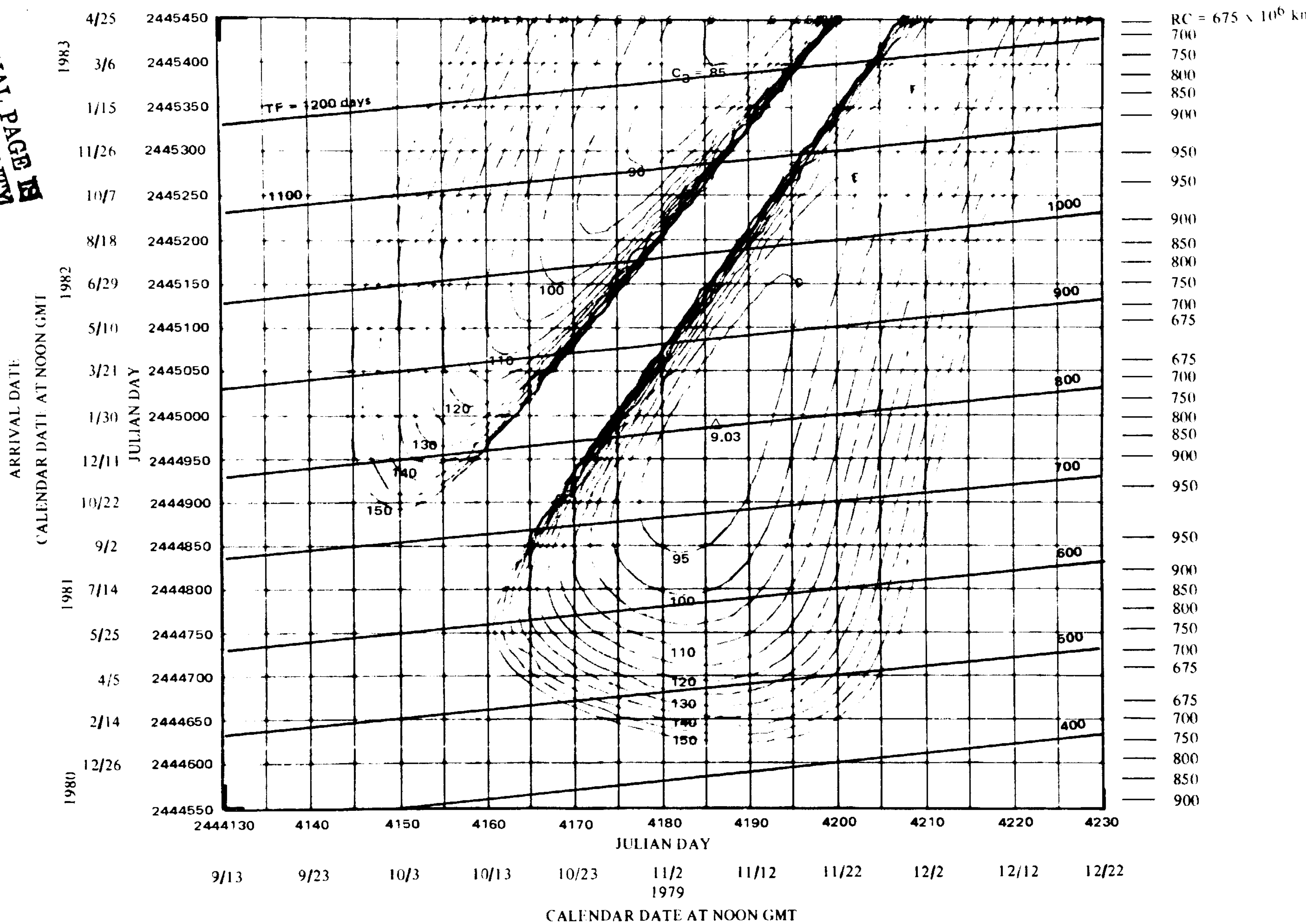

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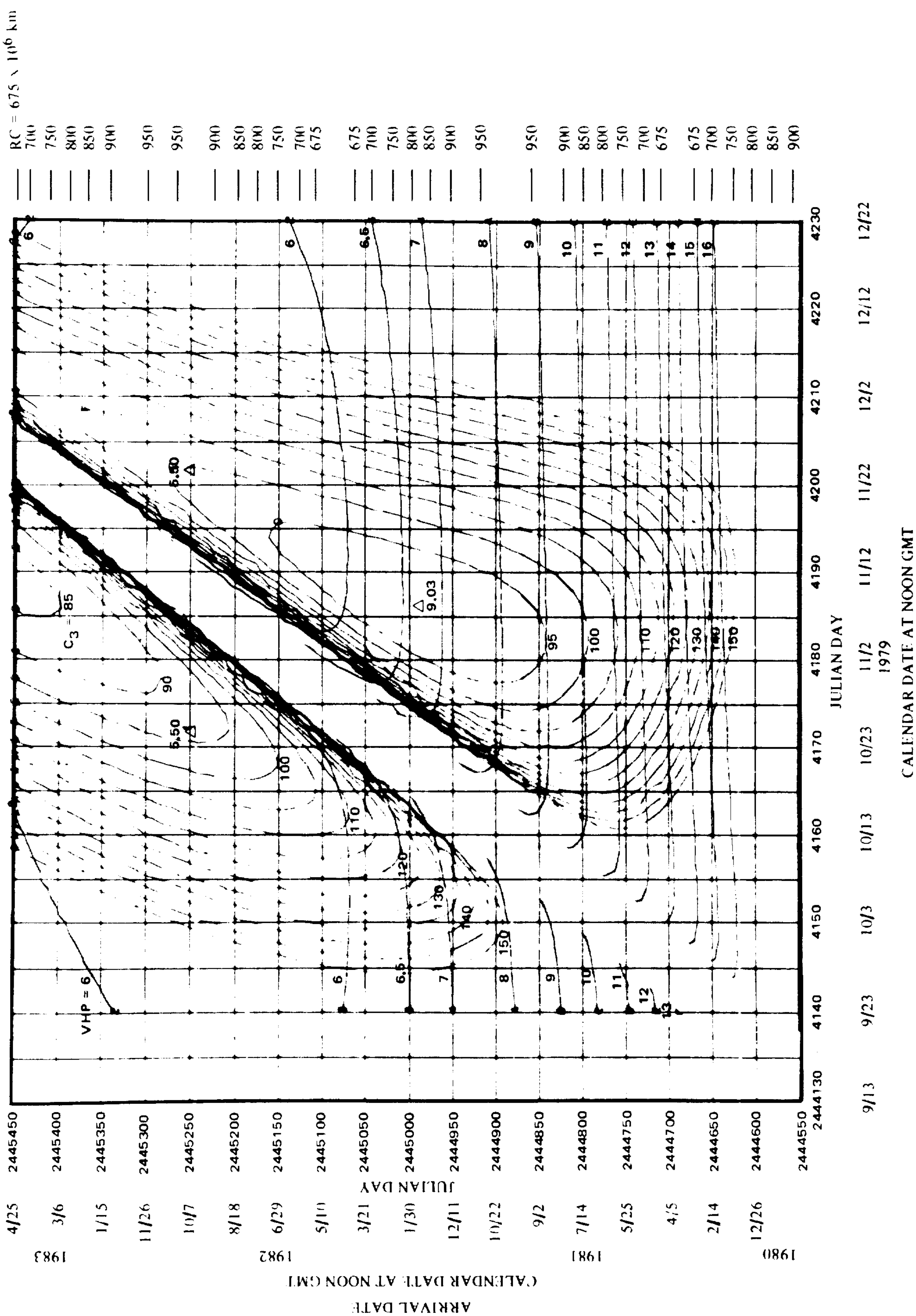

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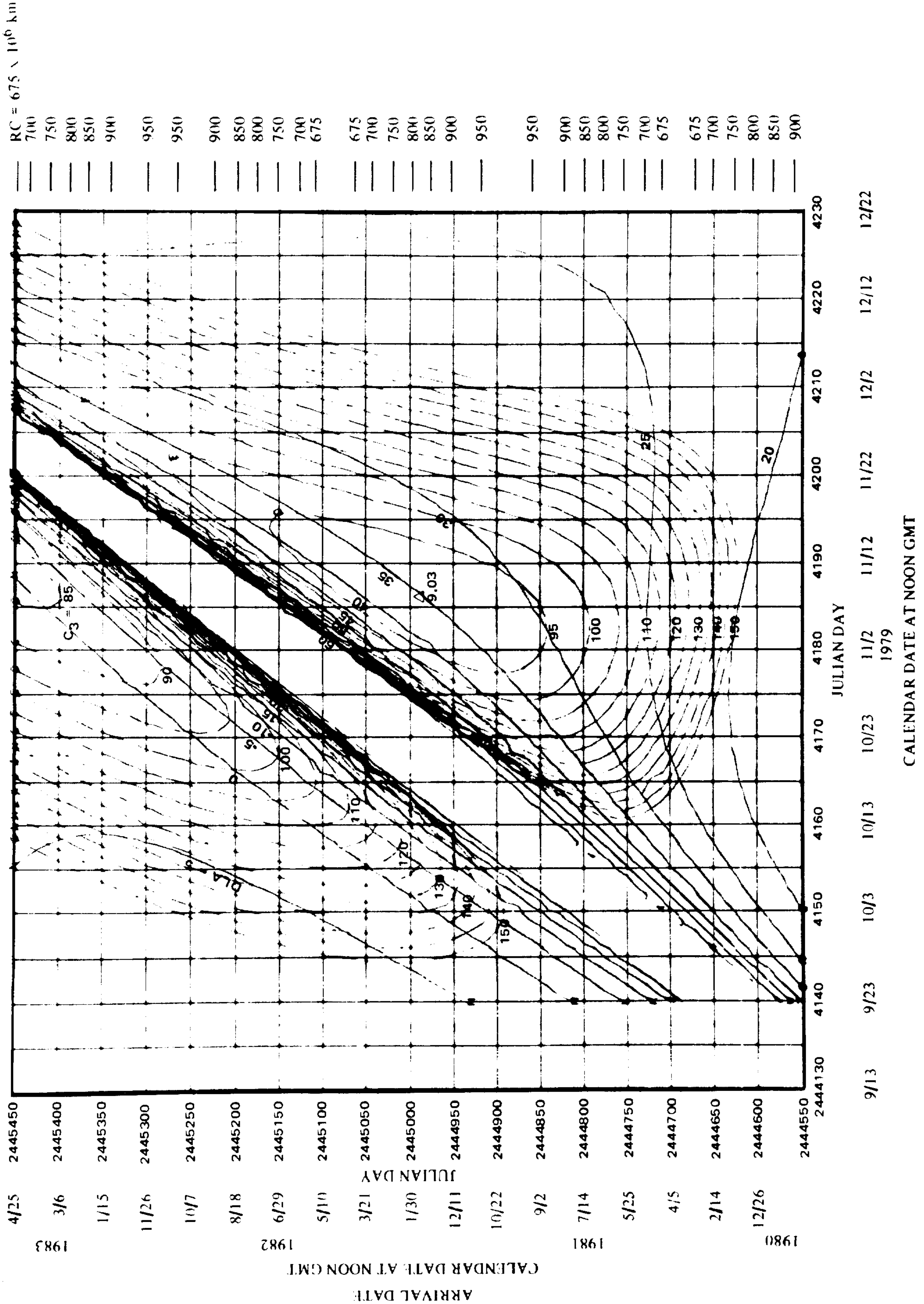

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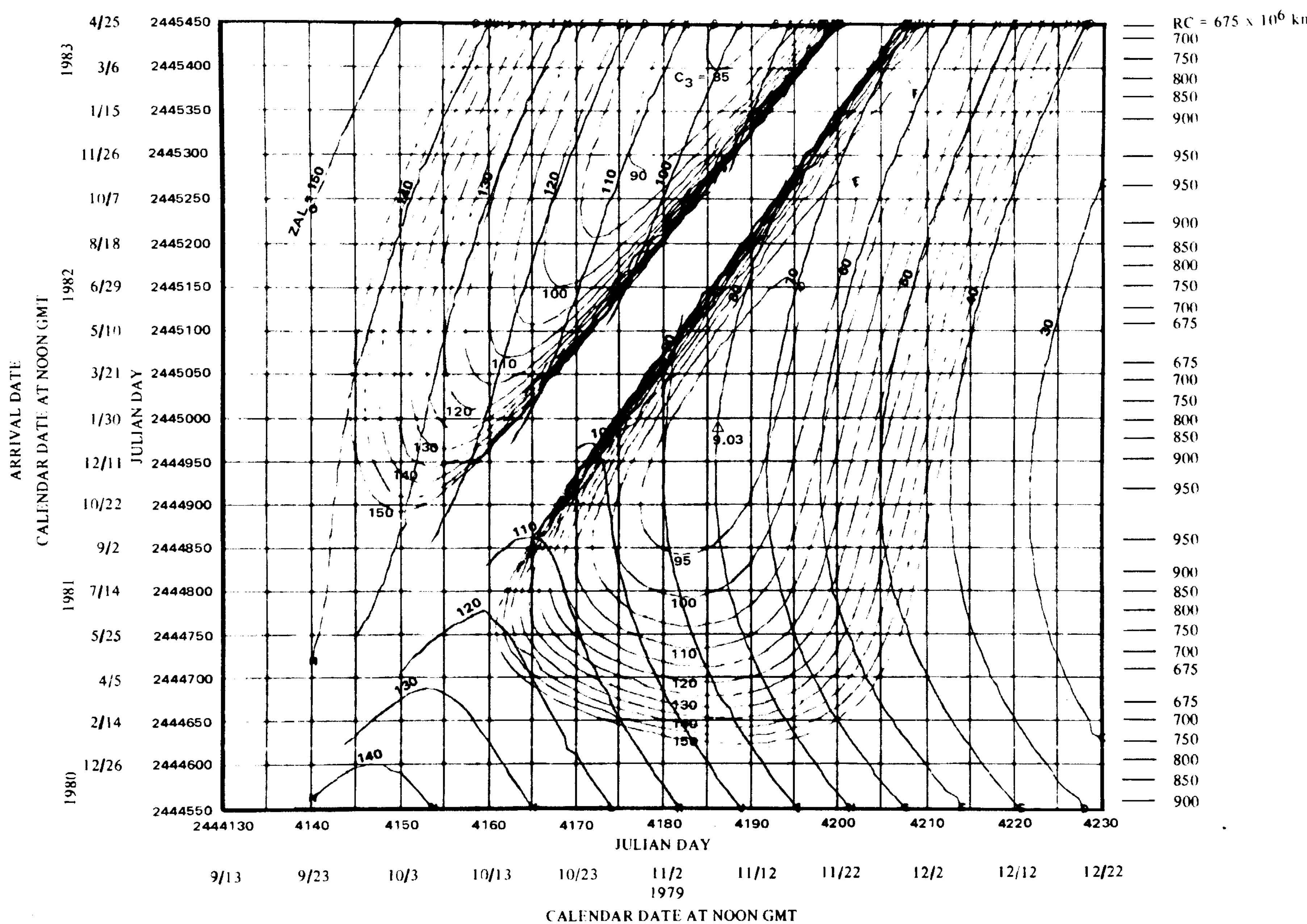

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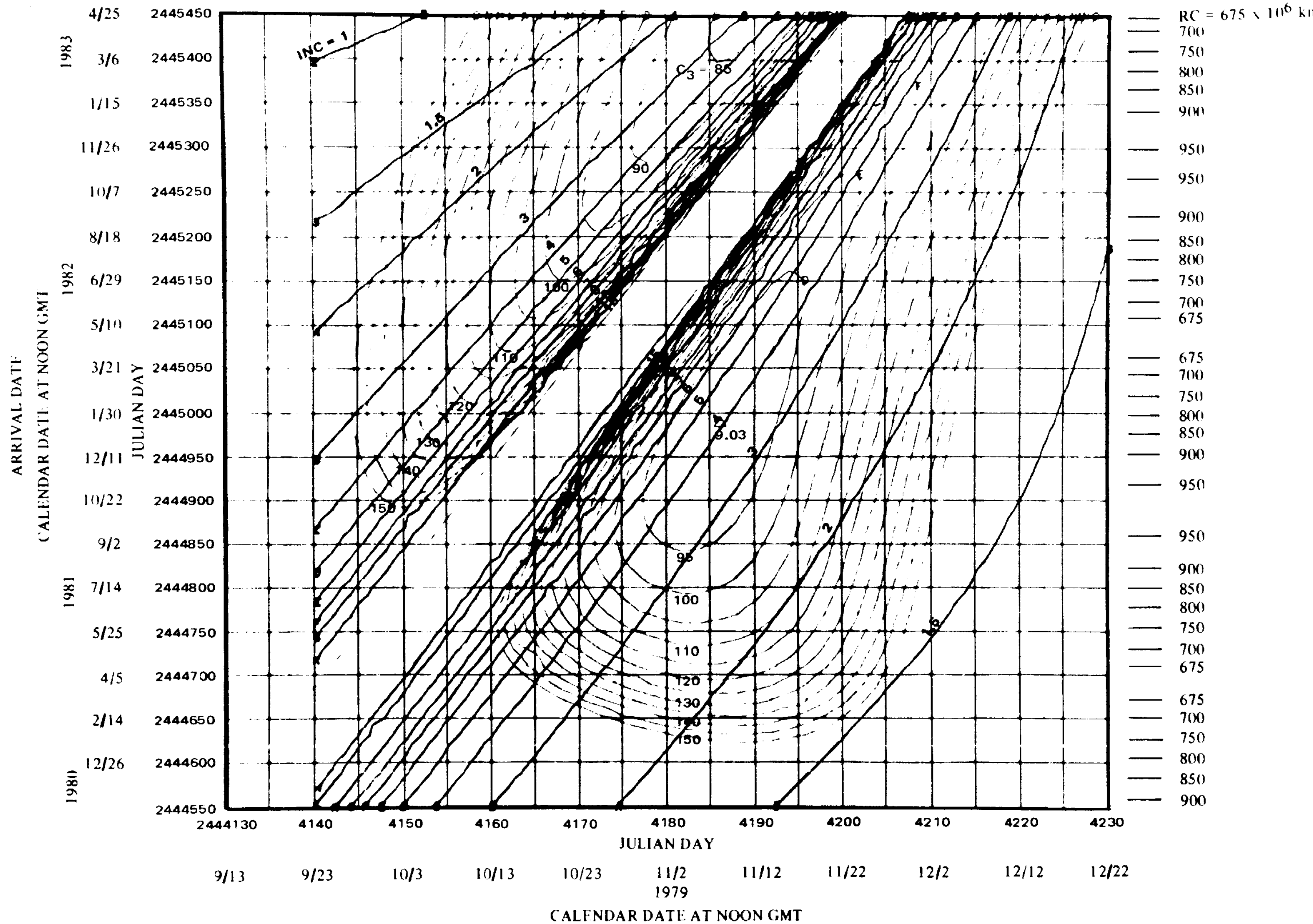

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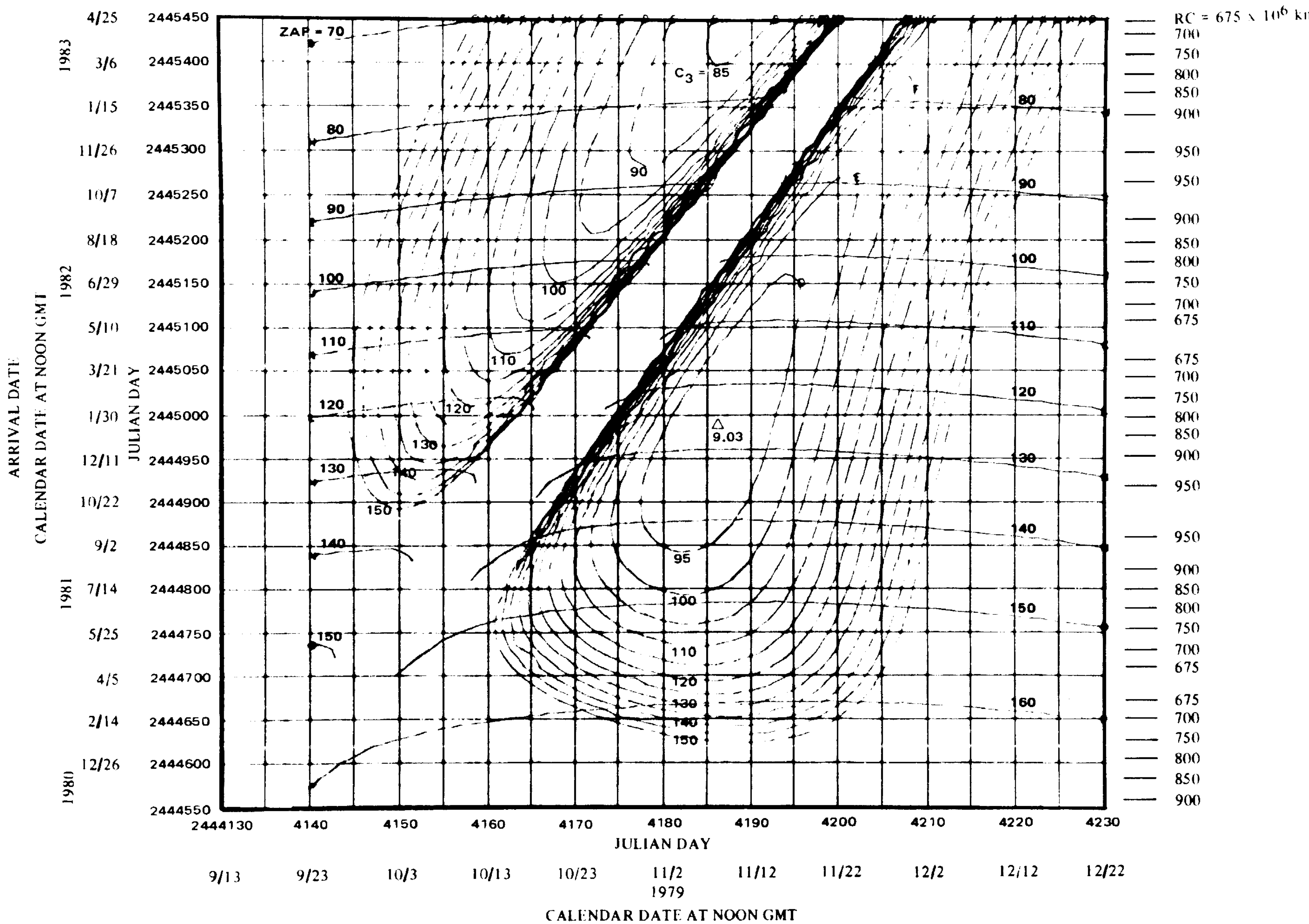

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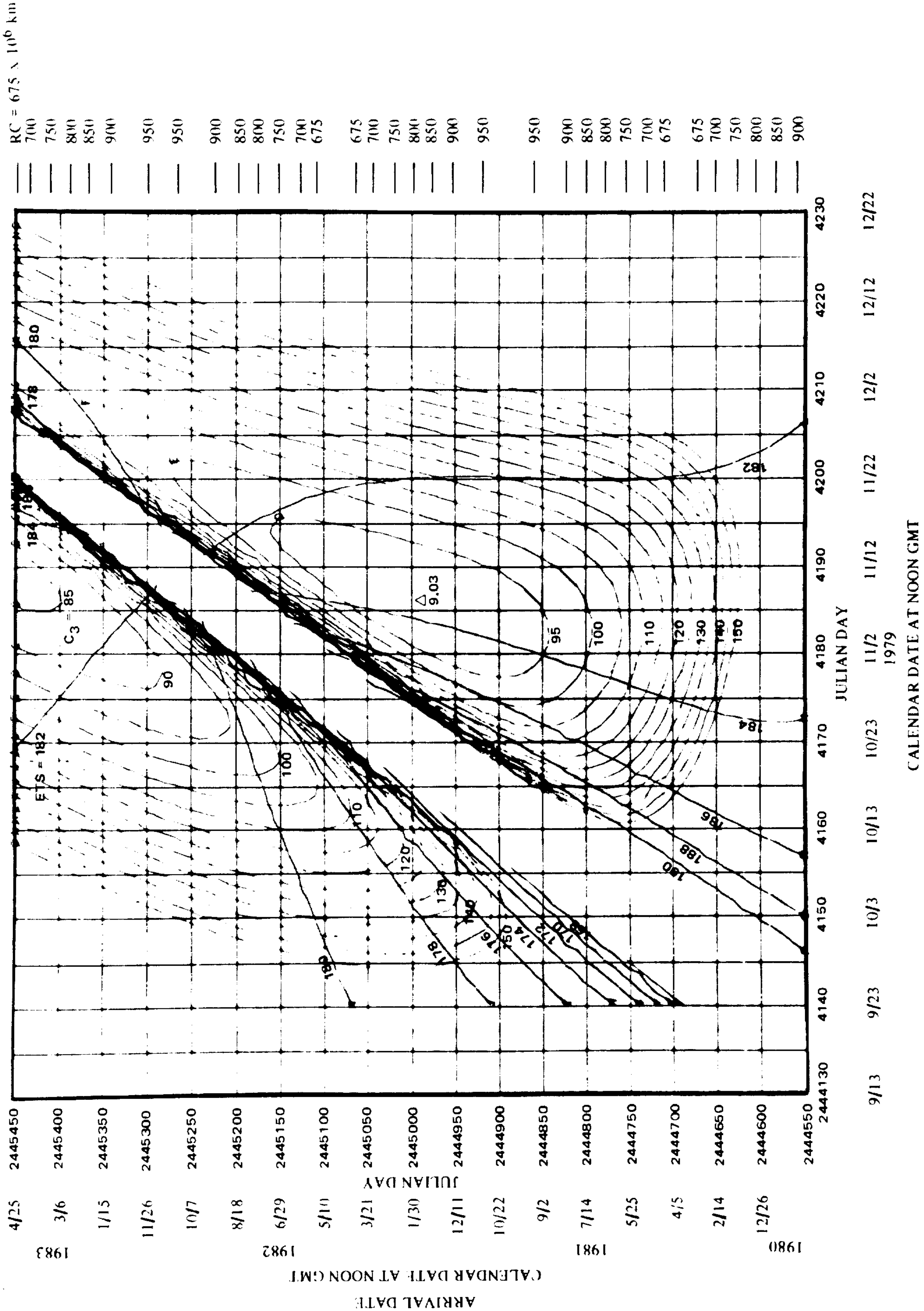

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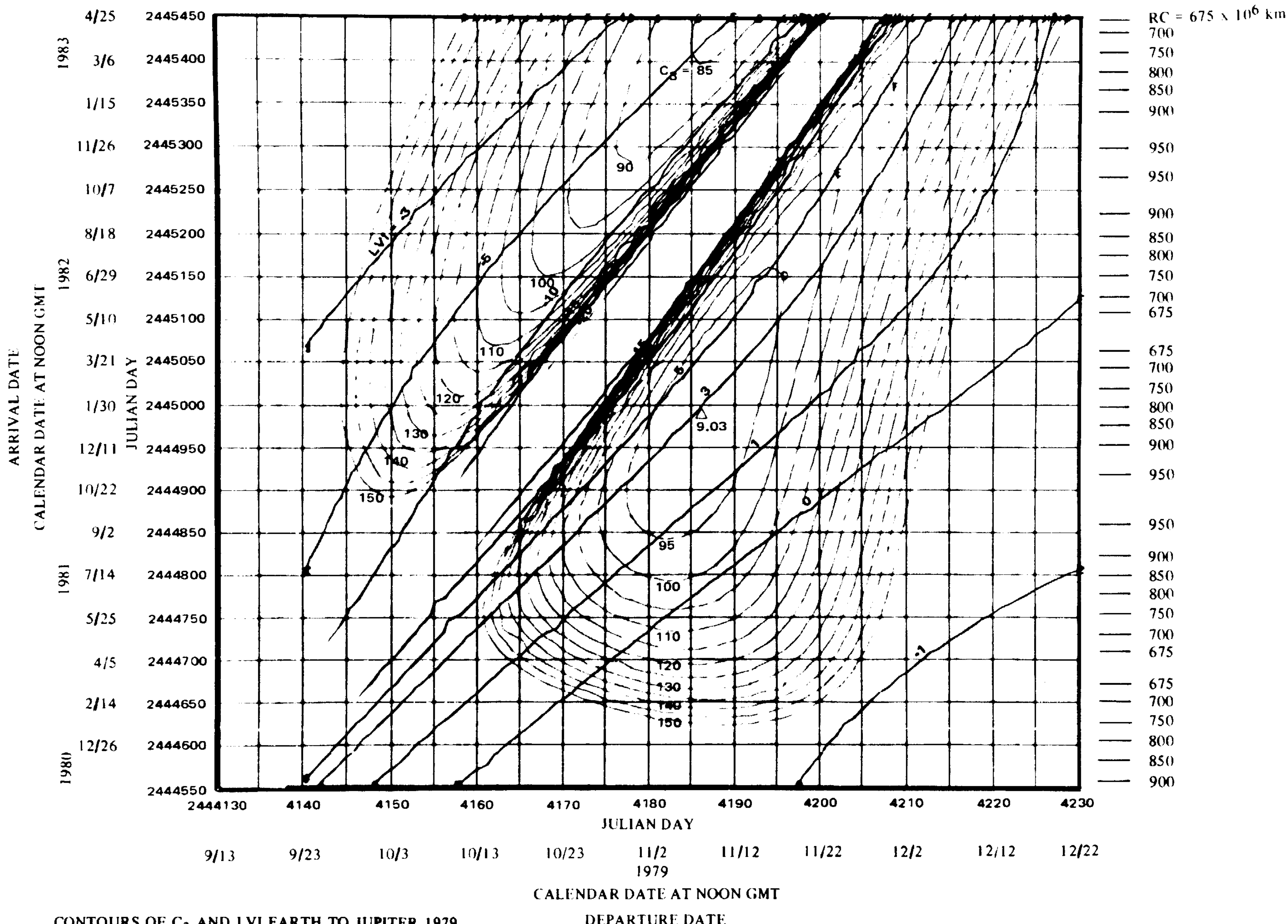

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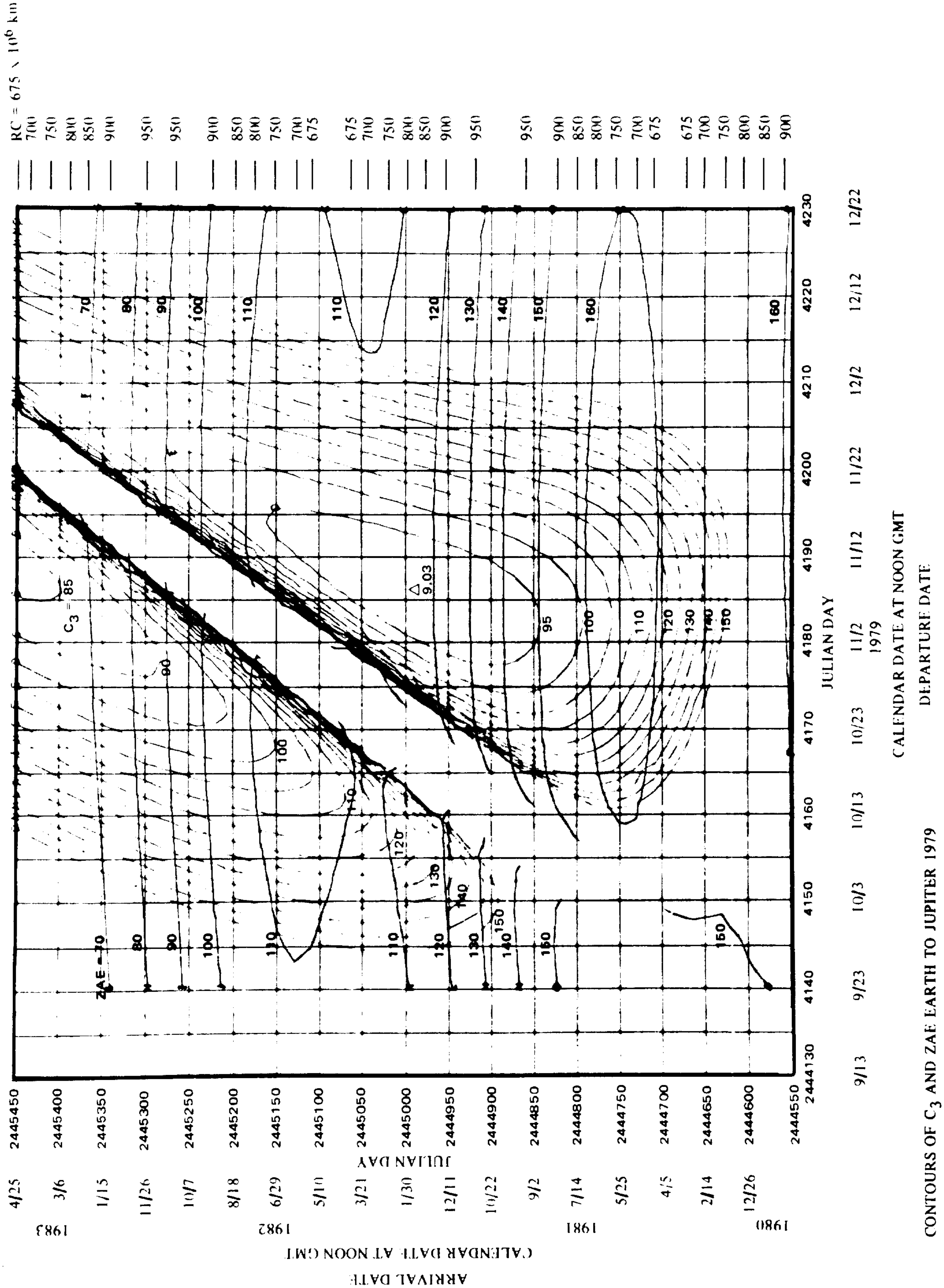

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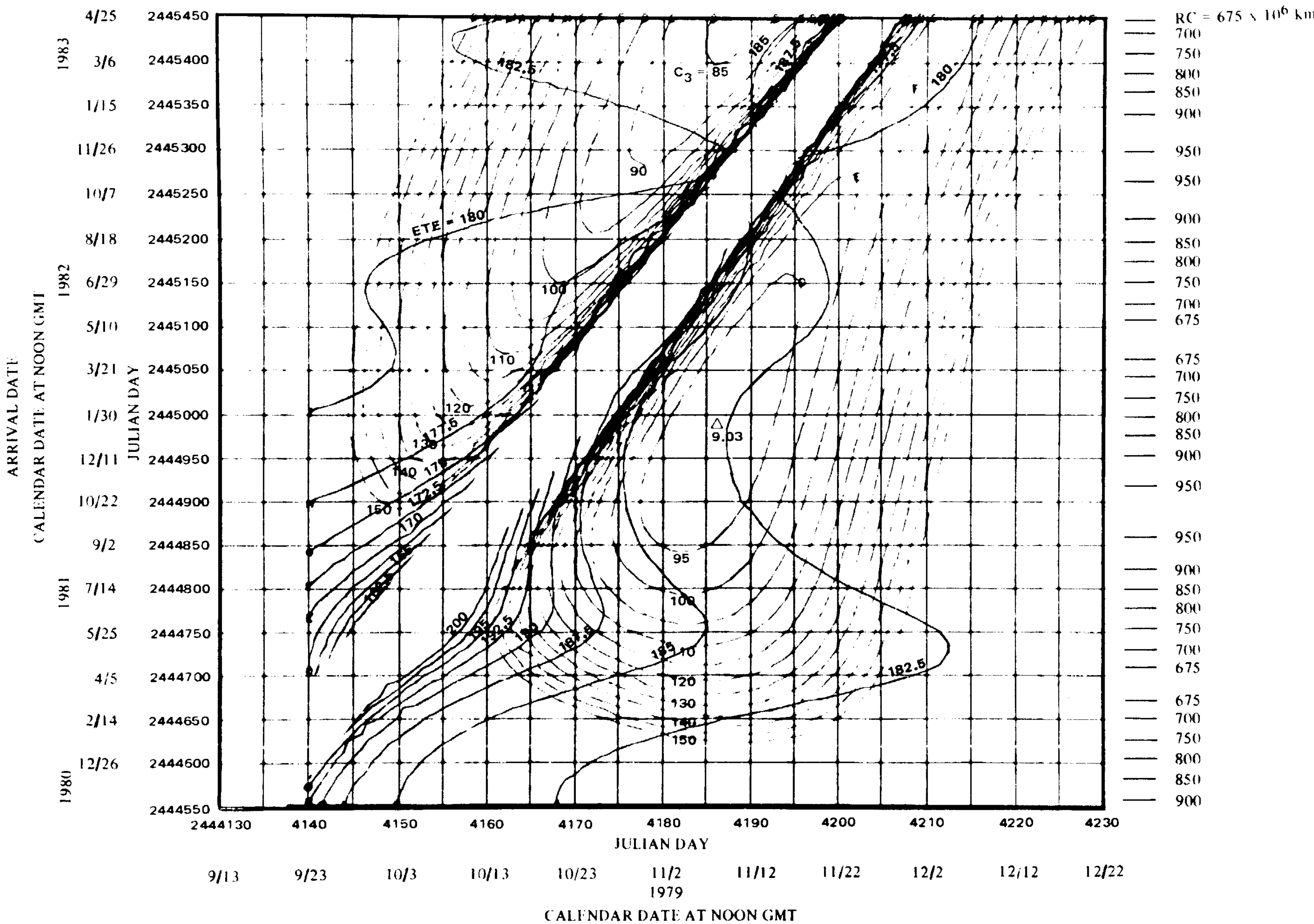

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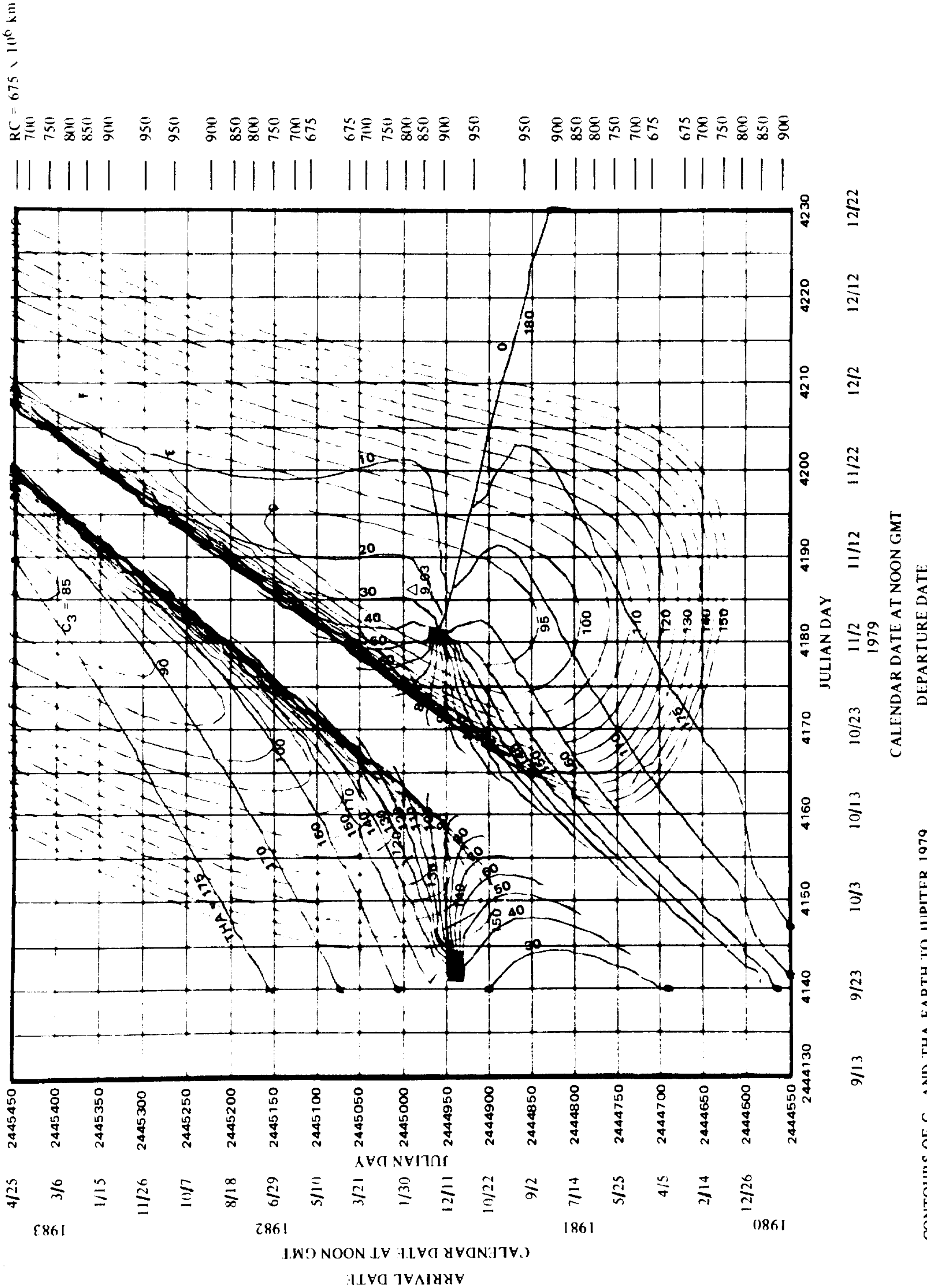
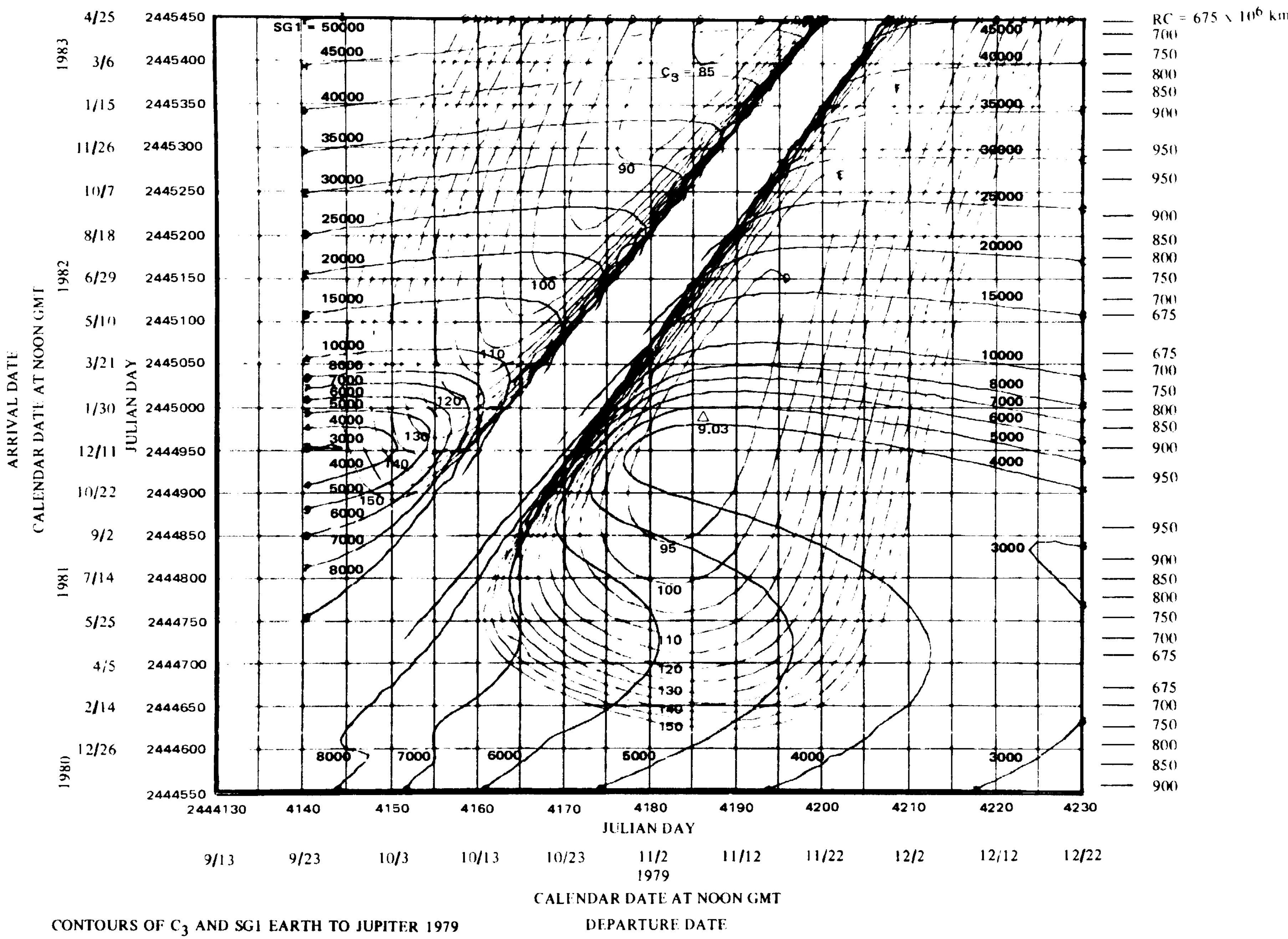


CONTOURS OF C_3 AND THA EARTH TO JUPITER 1979



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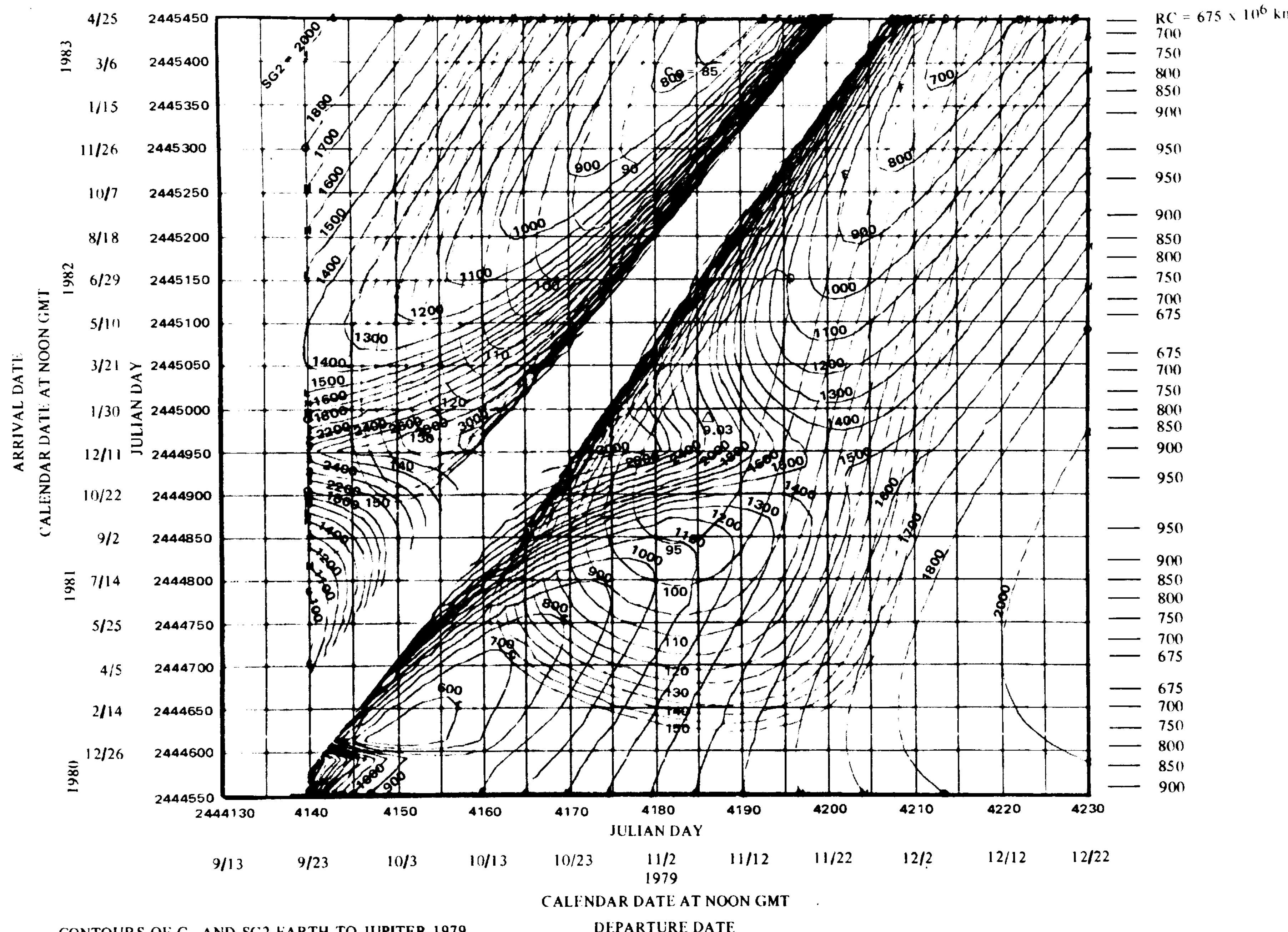

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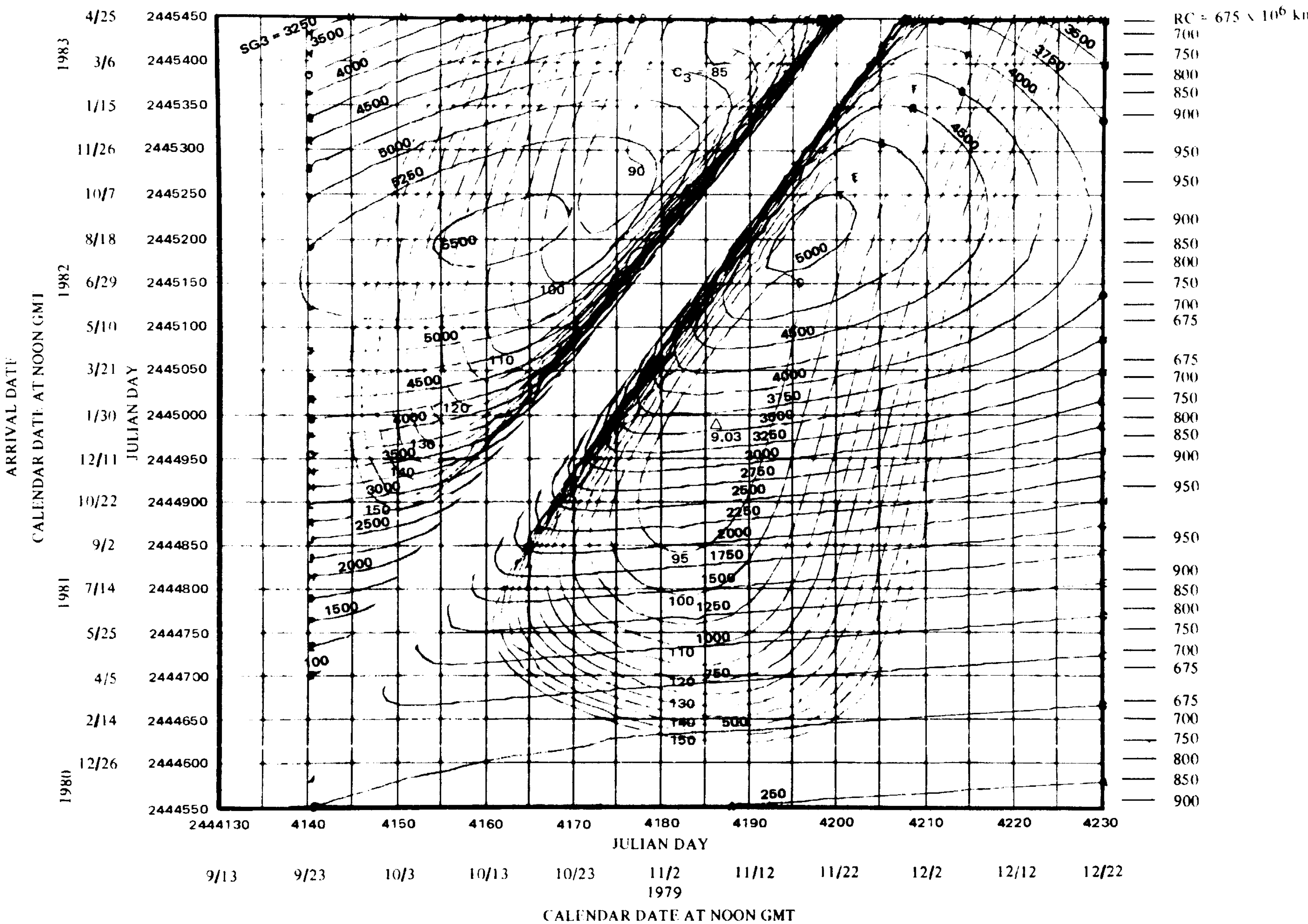
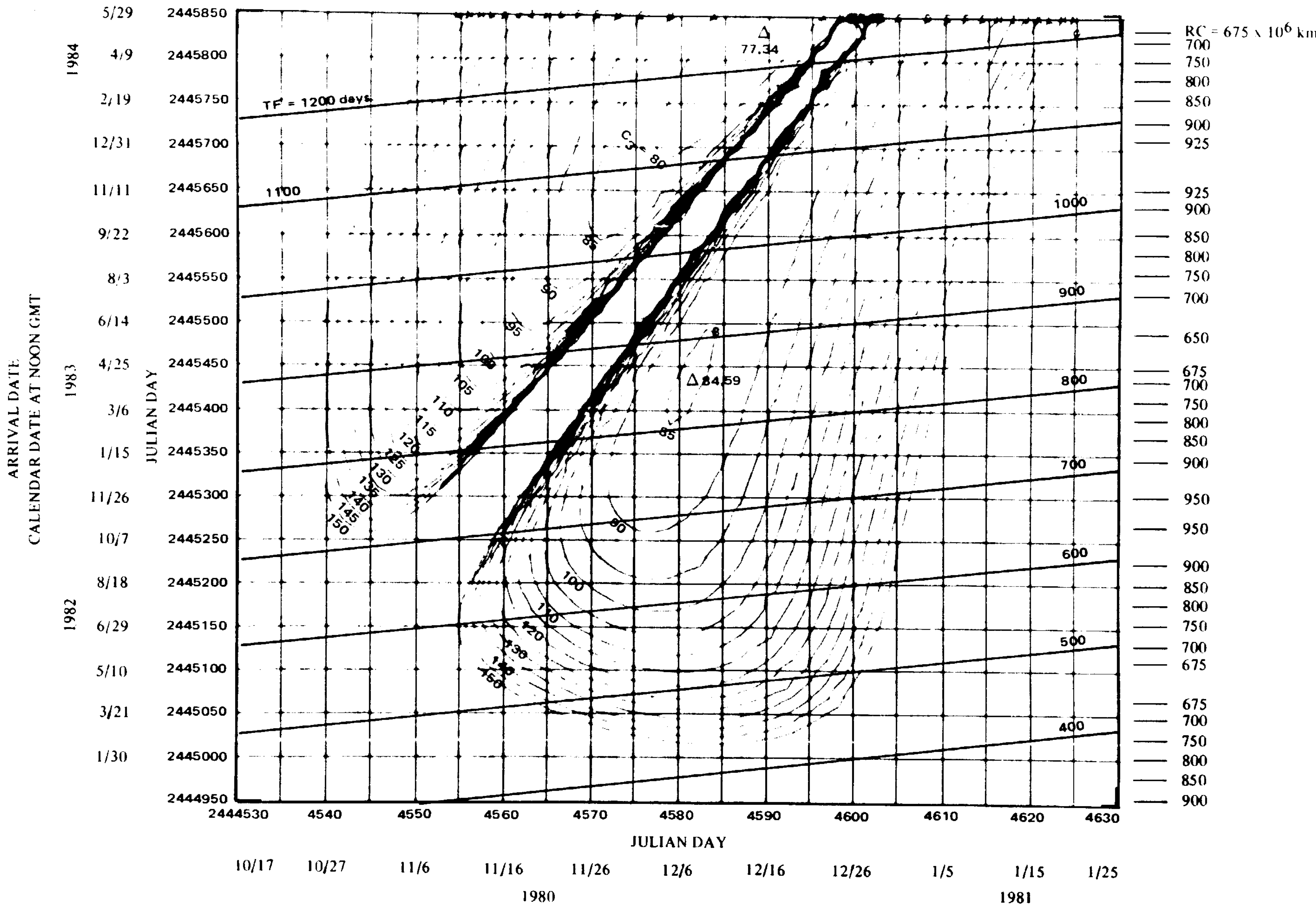
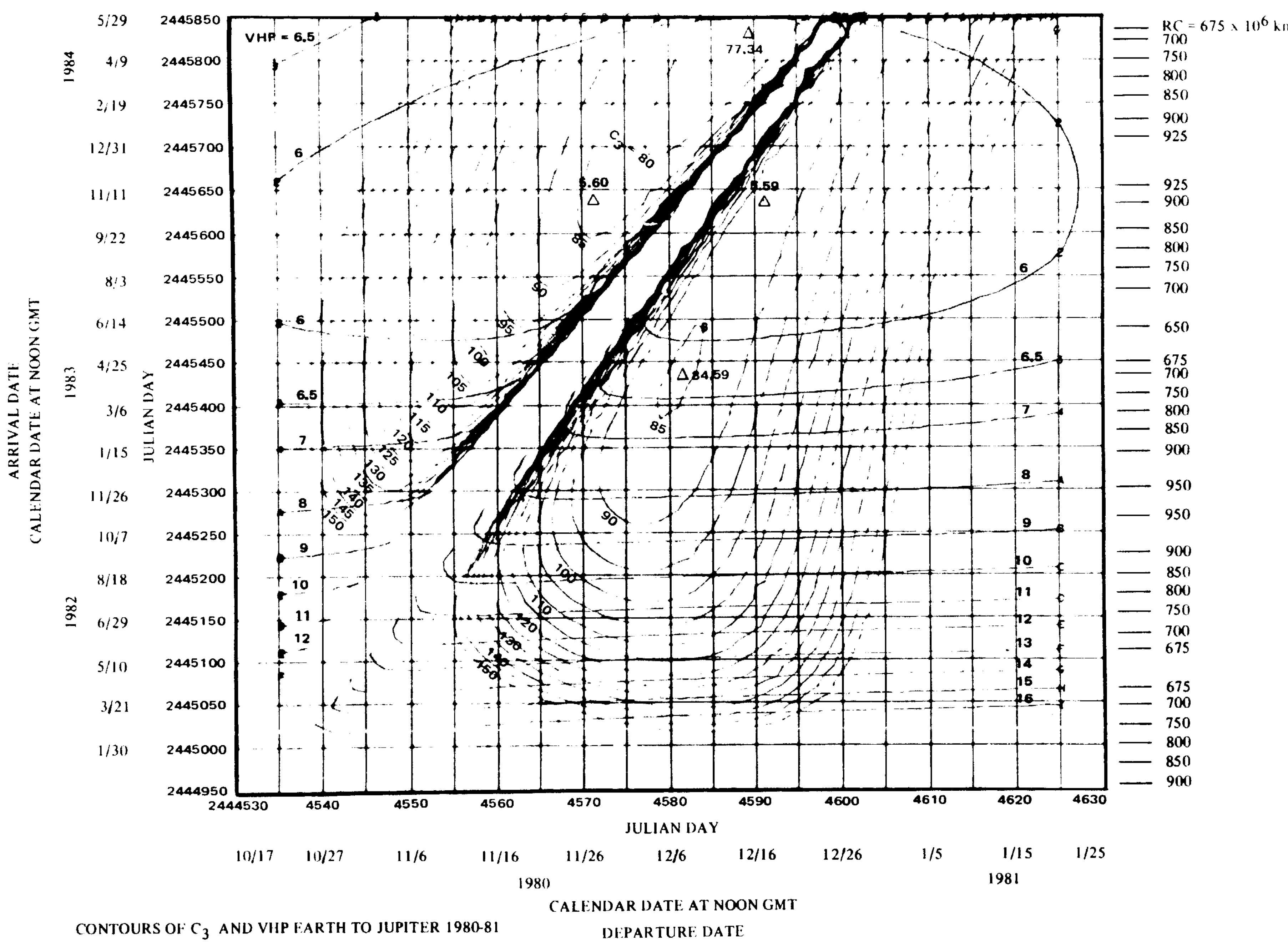


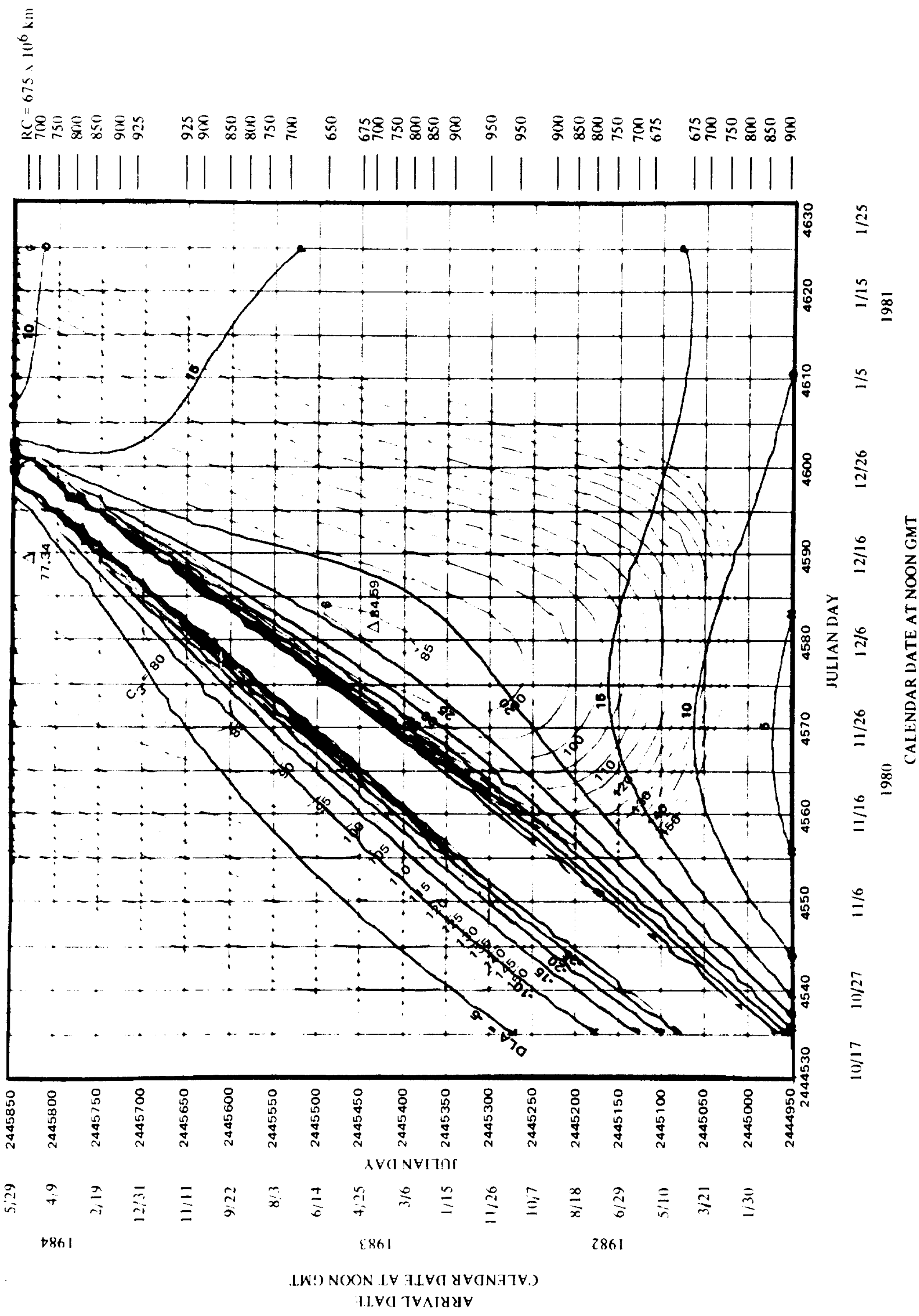
CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1979



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1980



CONTOURS OF C_3 AND VHP EARTH TO JUPITER 1980-81



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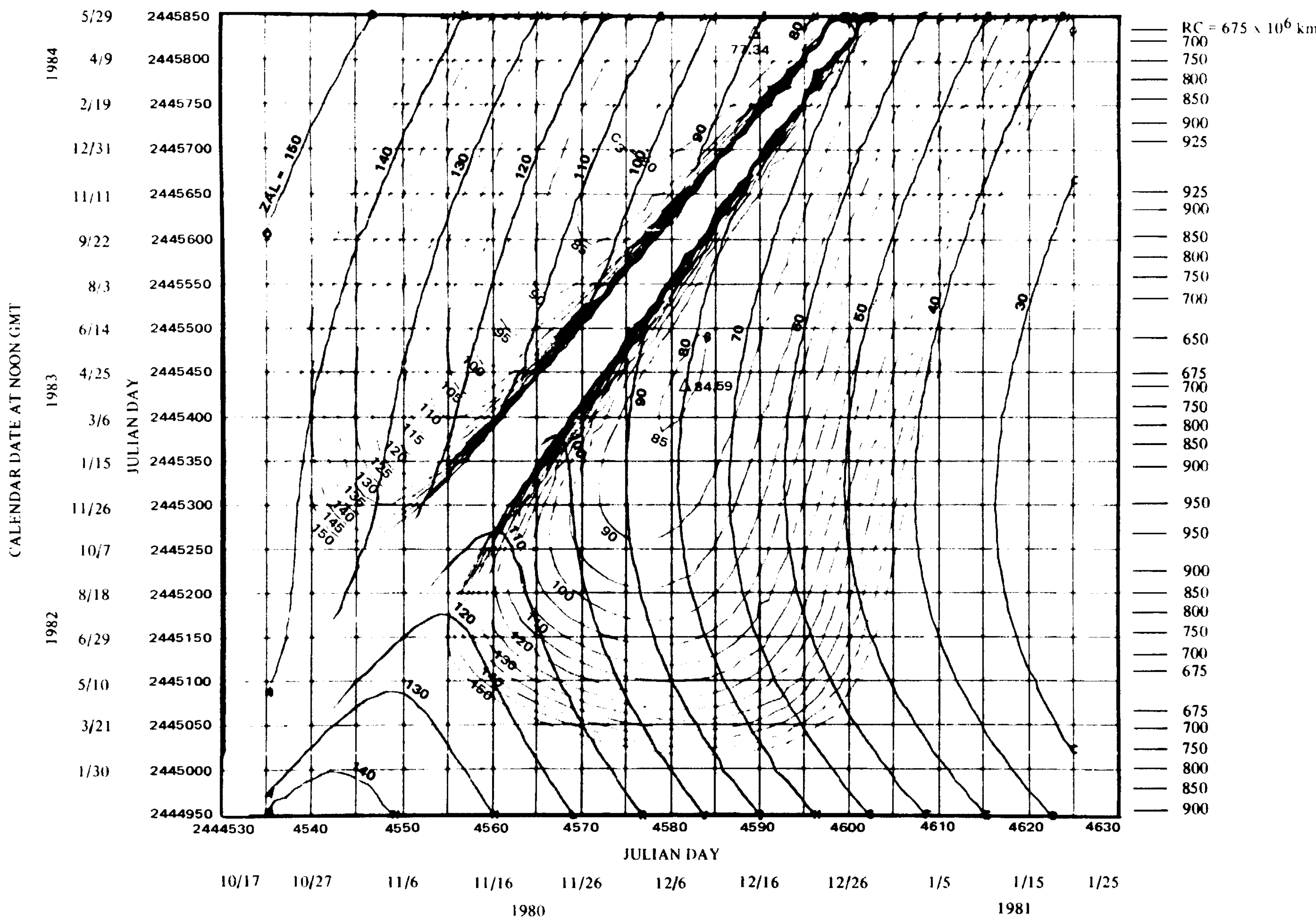

CALENDAR DATE AT NOON GMT
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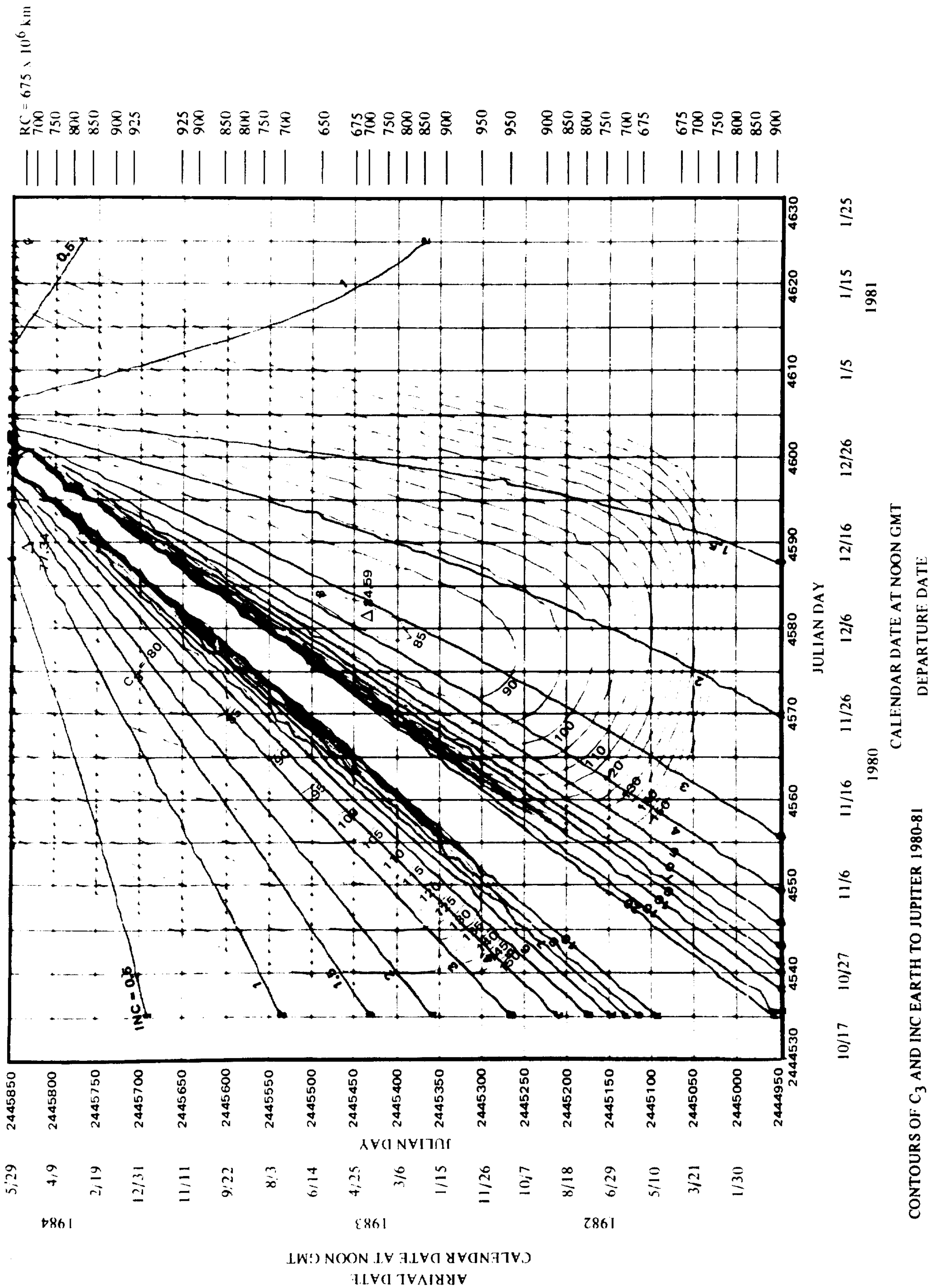
CONTOURS OF C_3 AND ZAL EARTH TO JUPITER 1980-81



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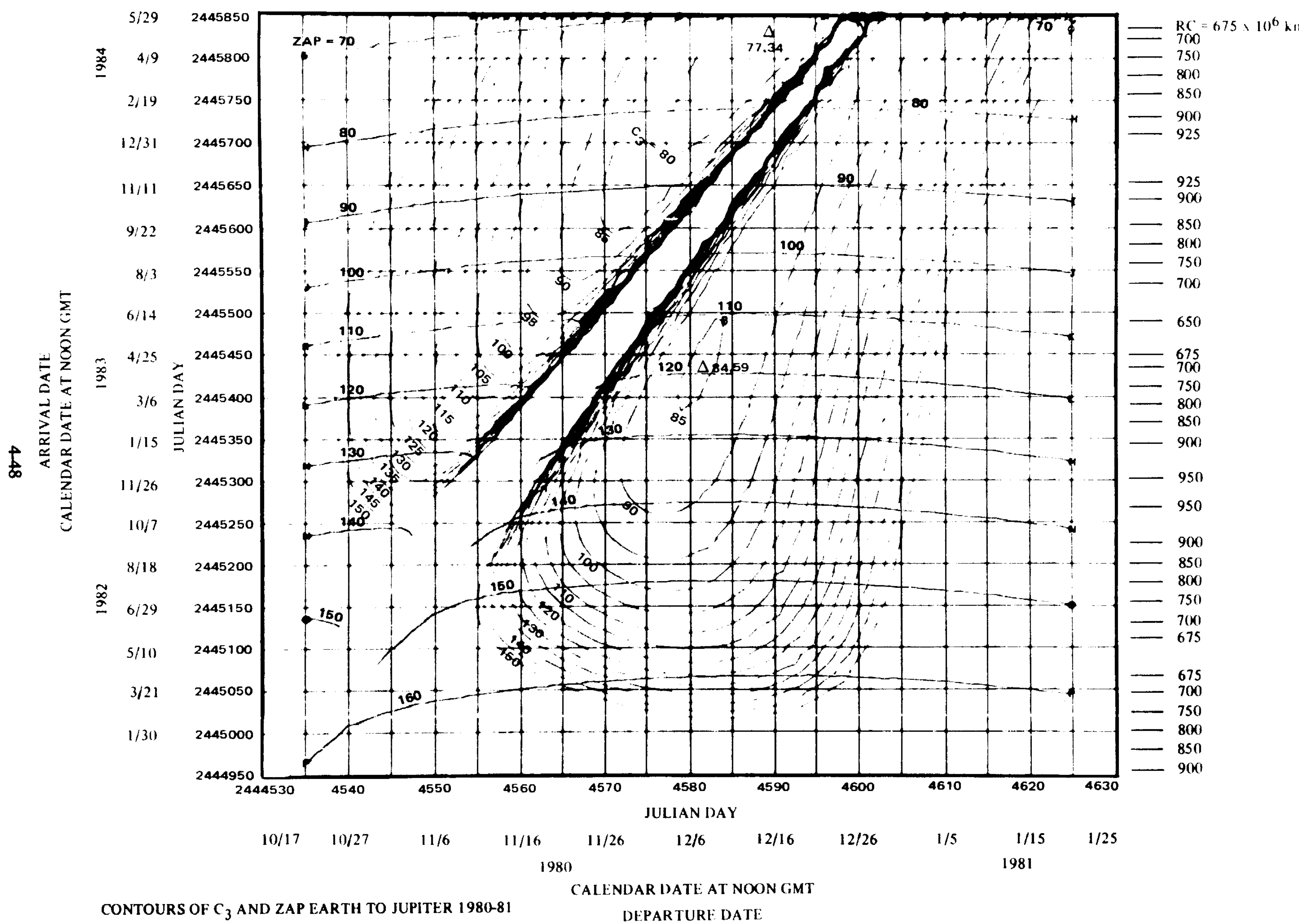

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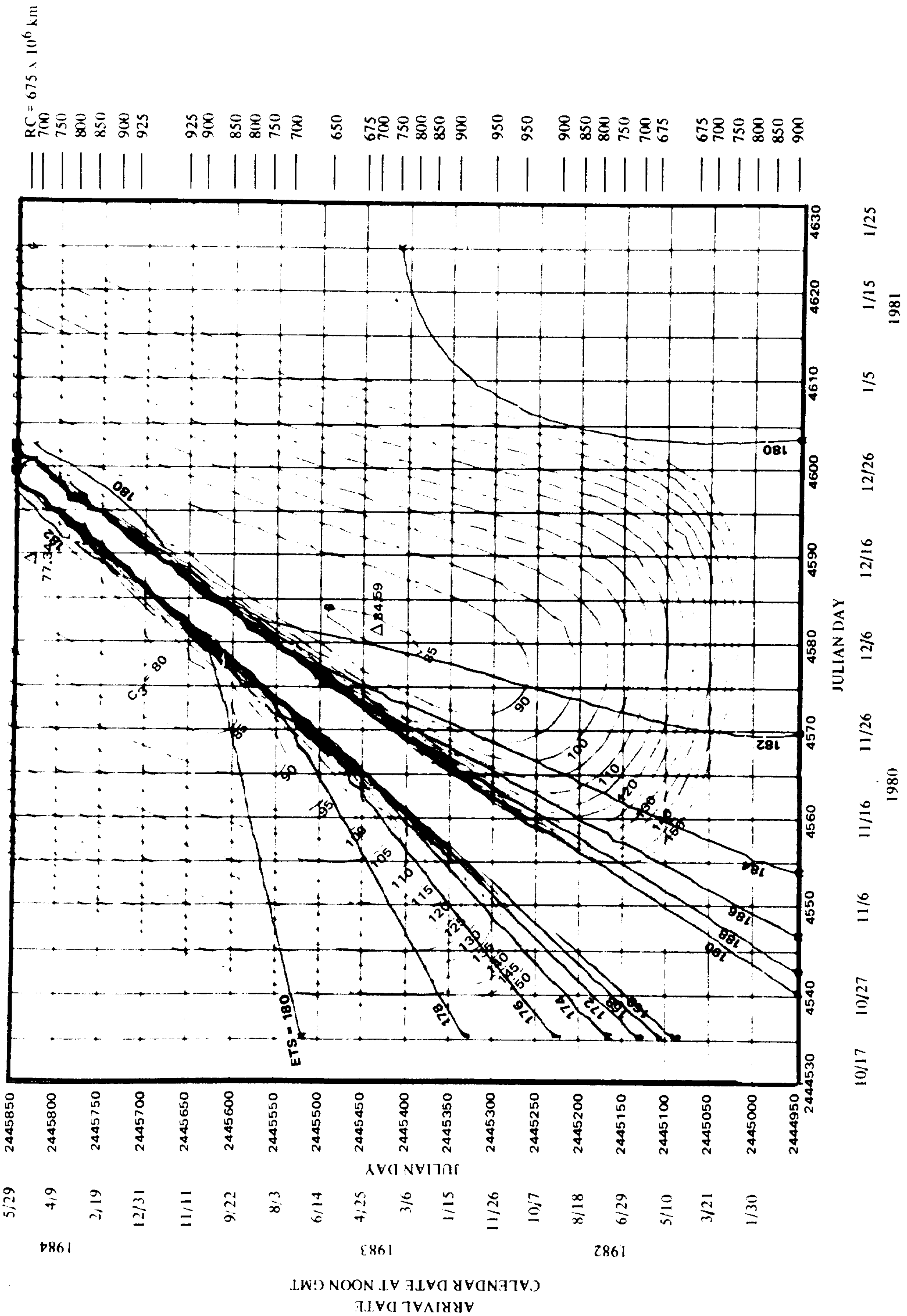

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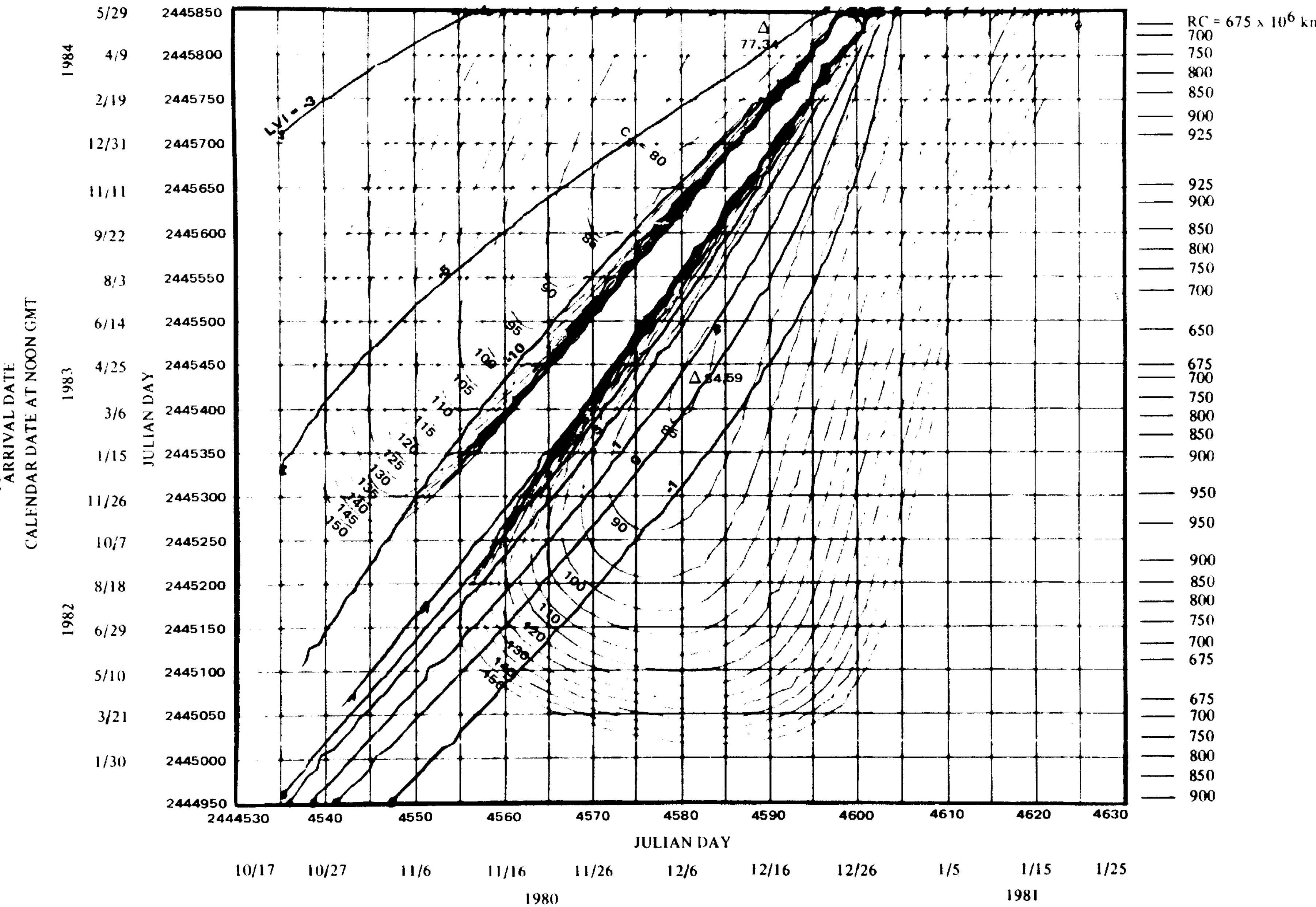

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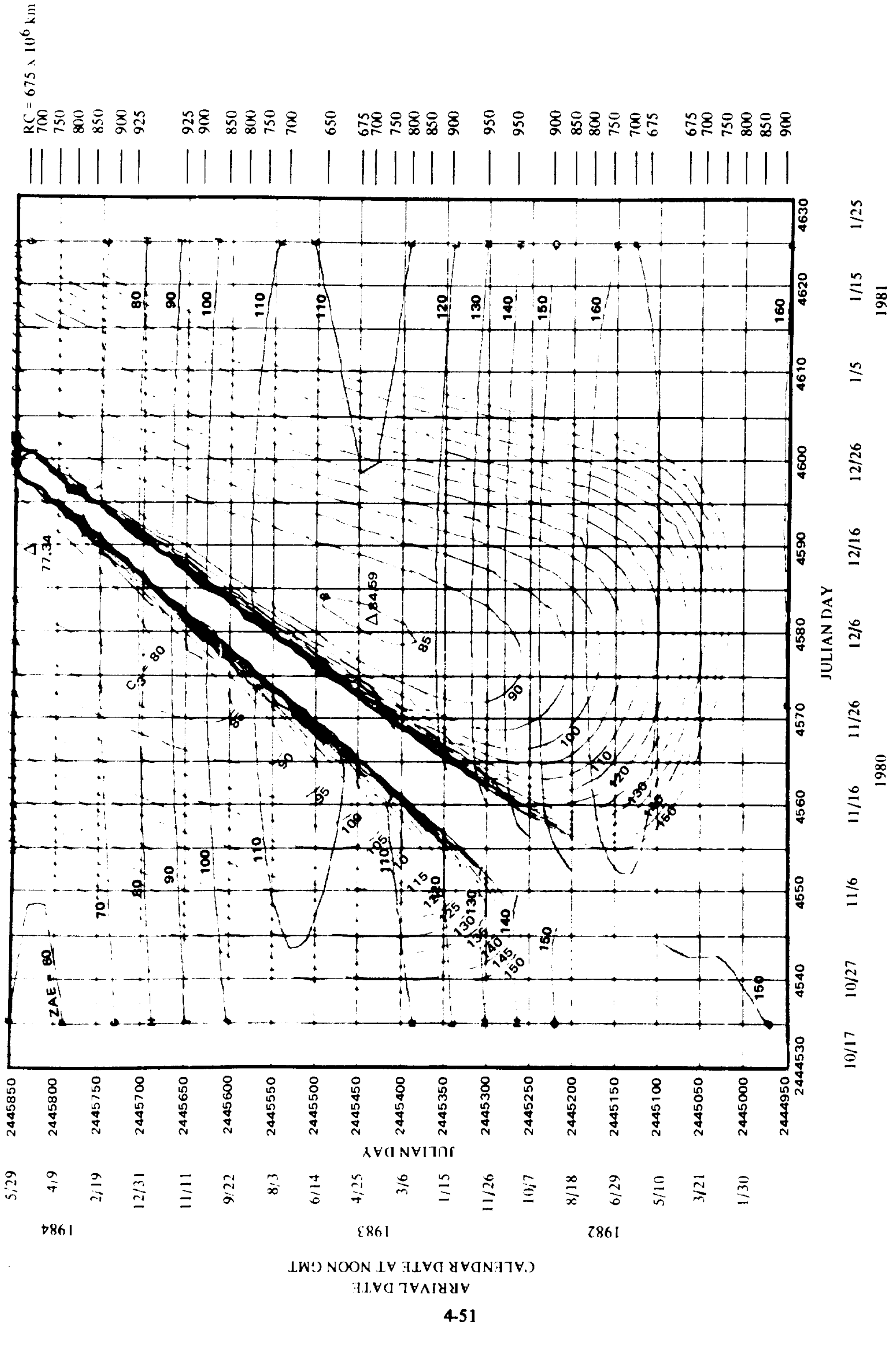

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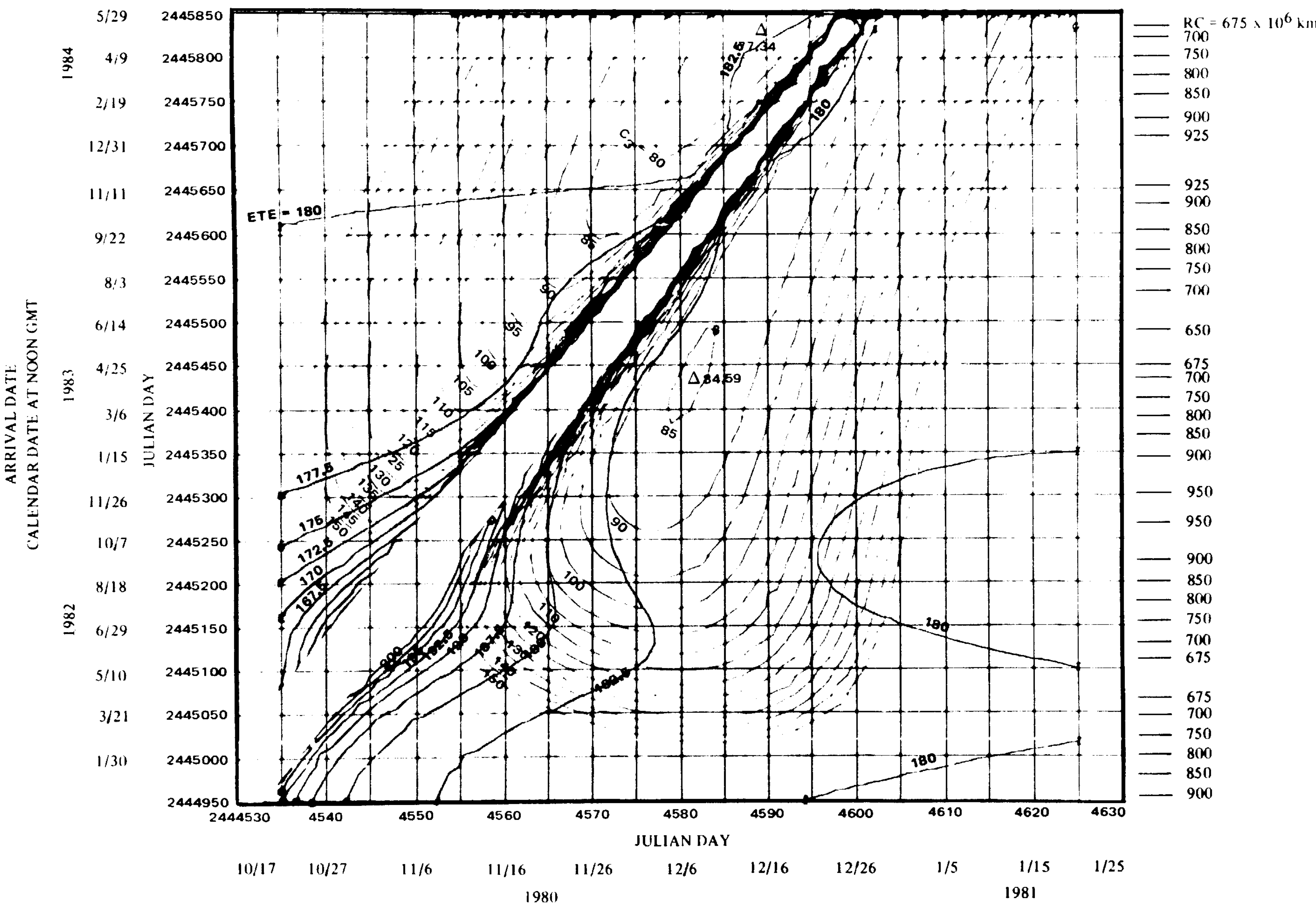

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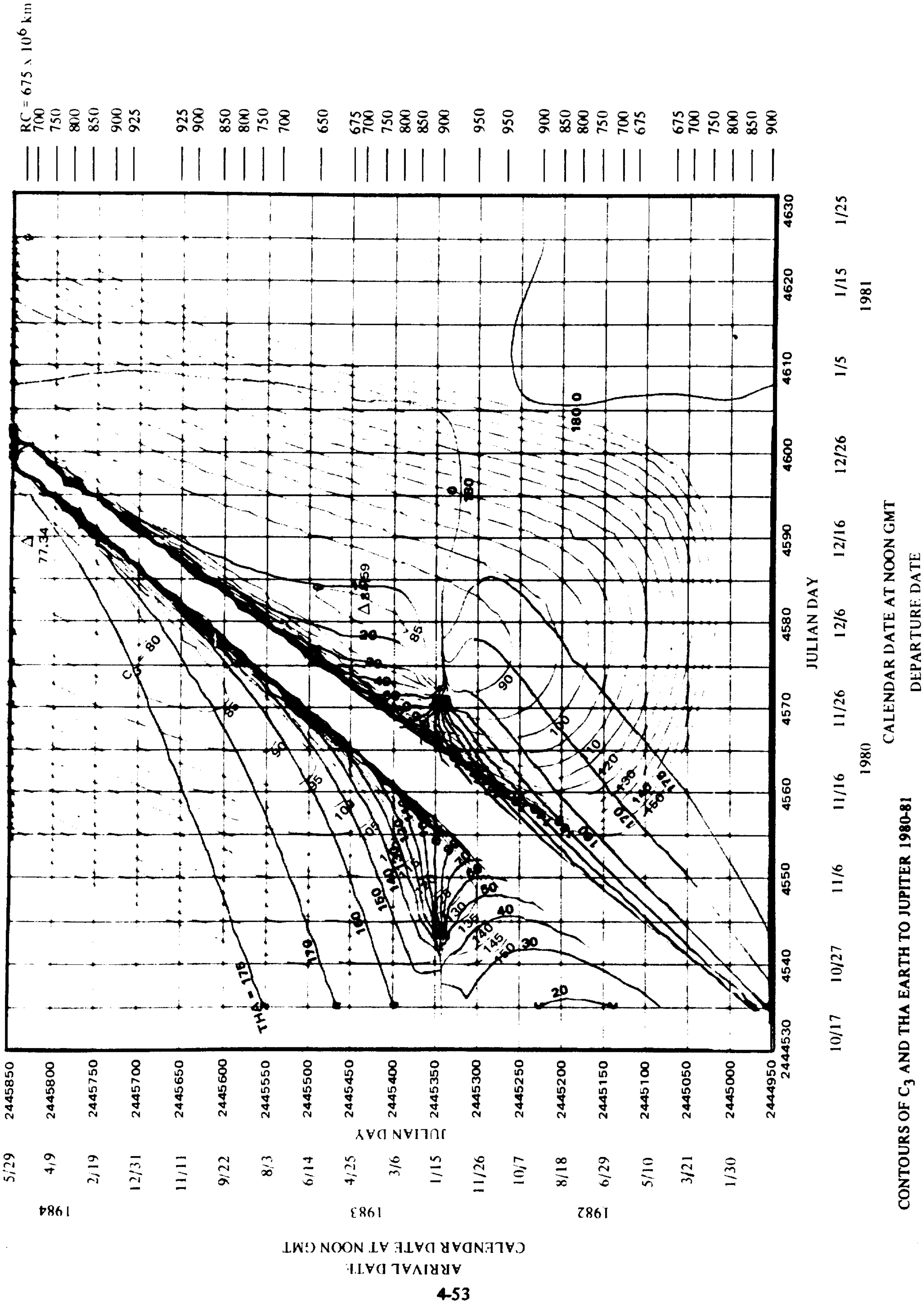

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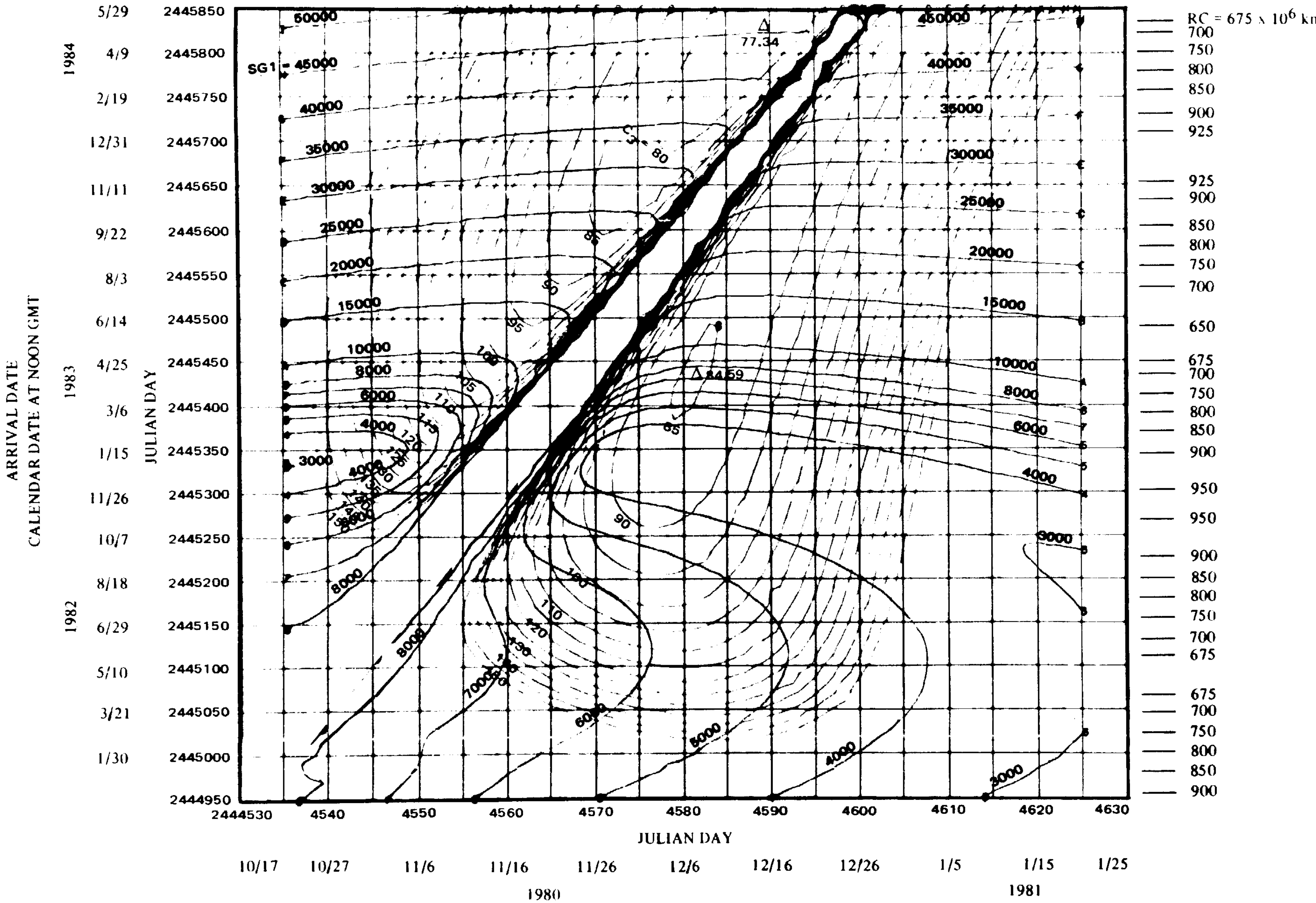

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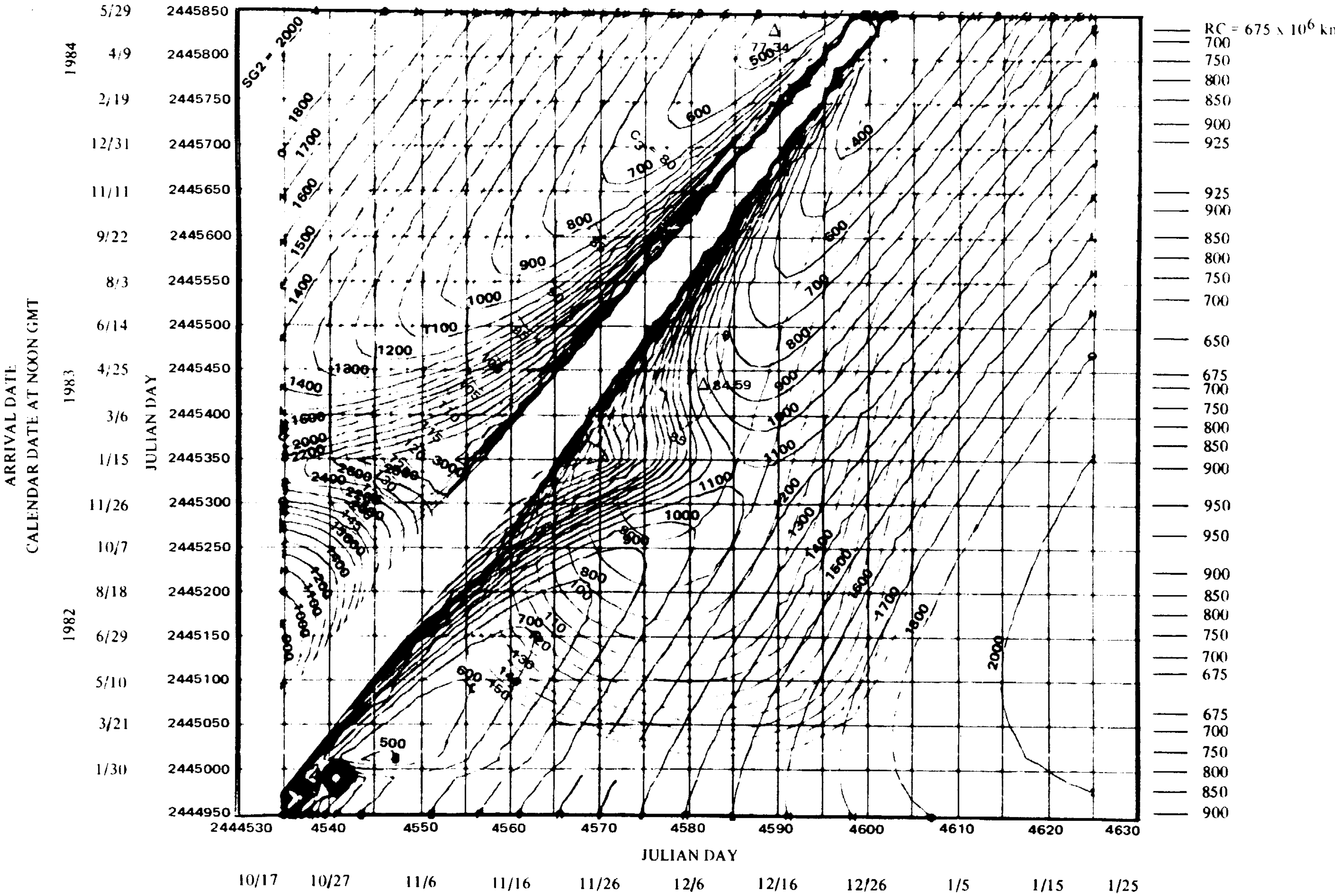

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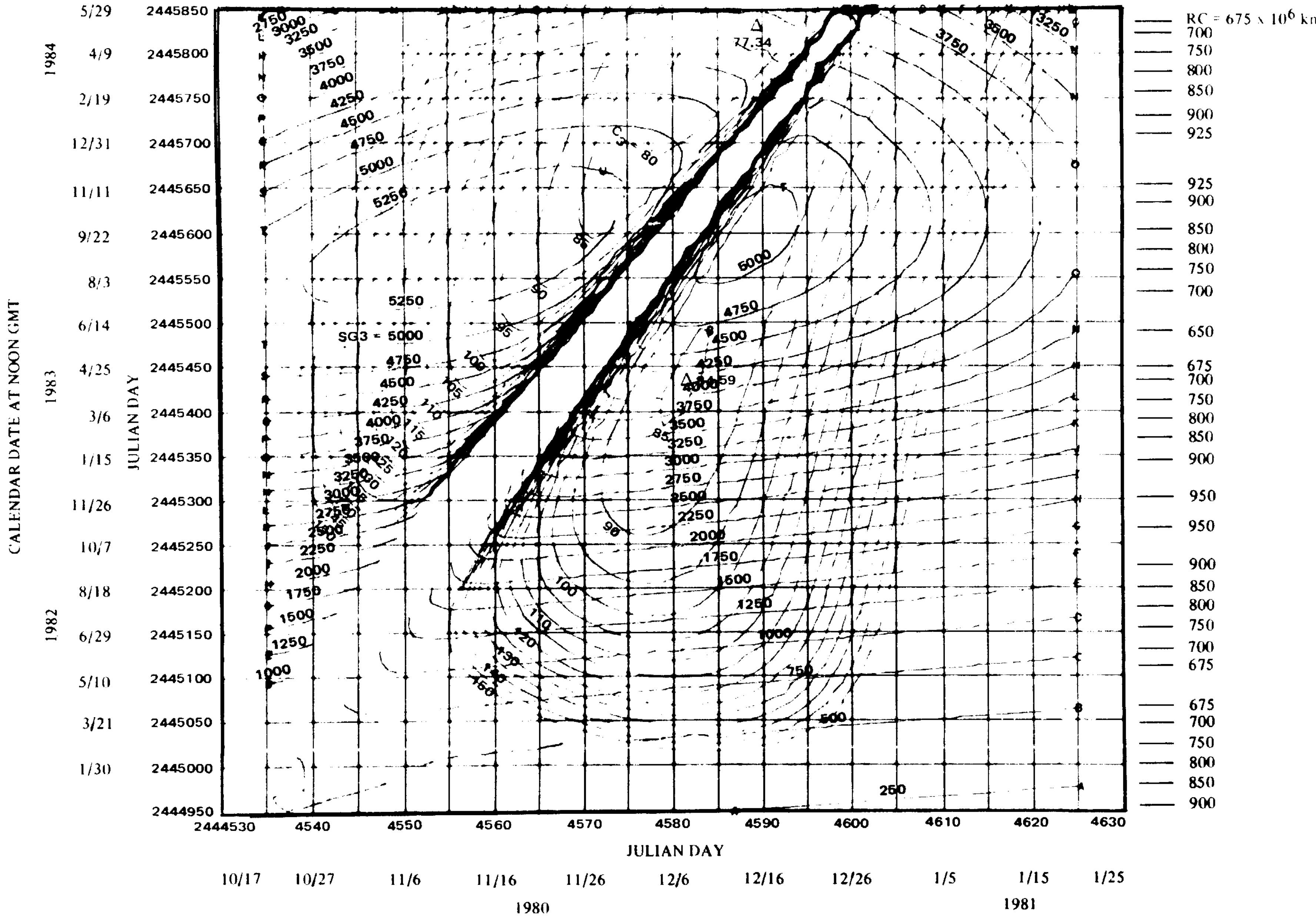
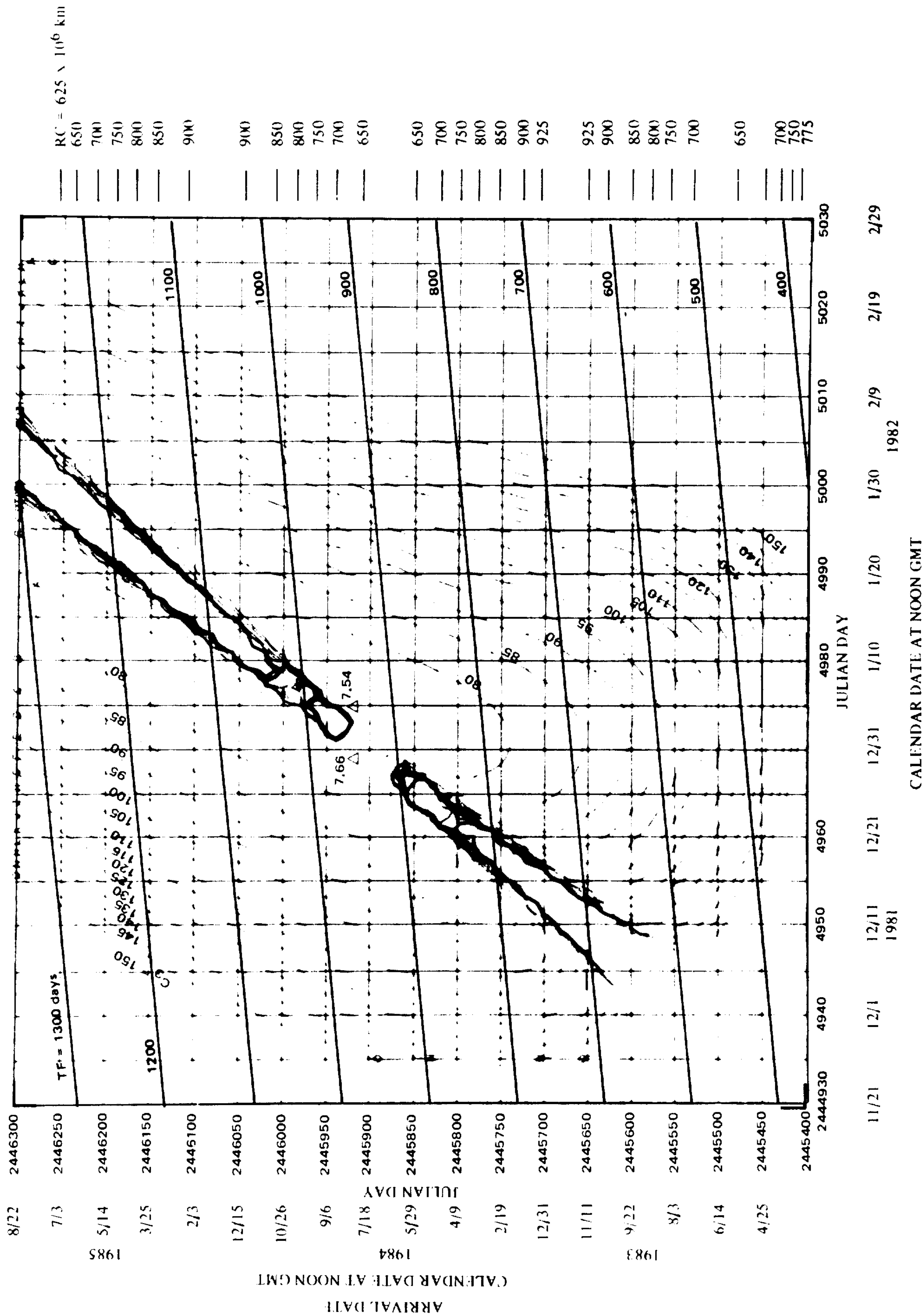
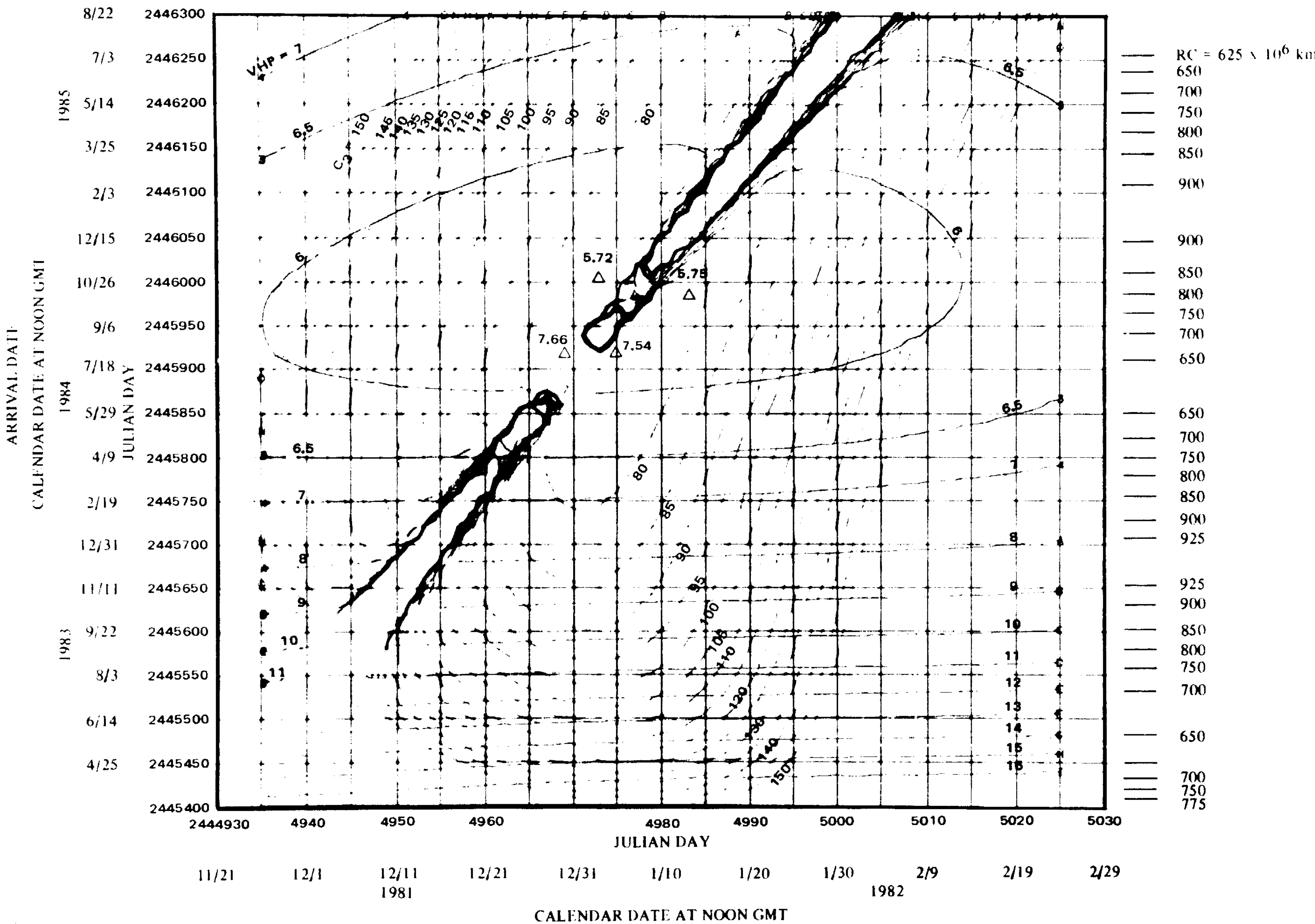


CALENDAR DATE AT NOON GMT
DEPARTURE DATE

CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1980-81



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1982



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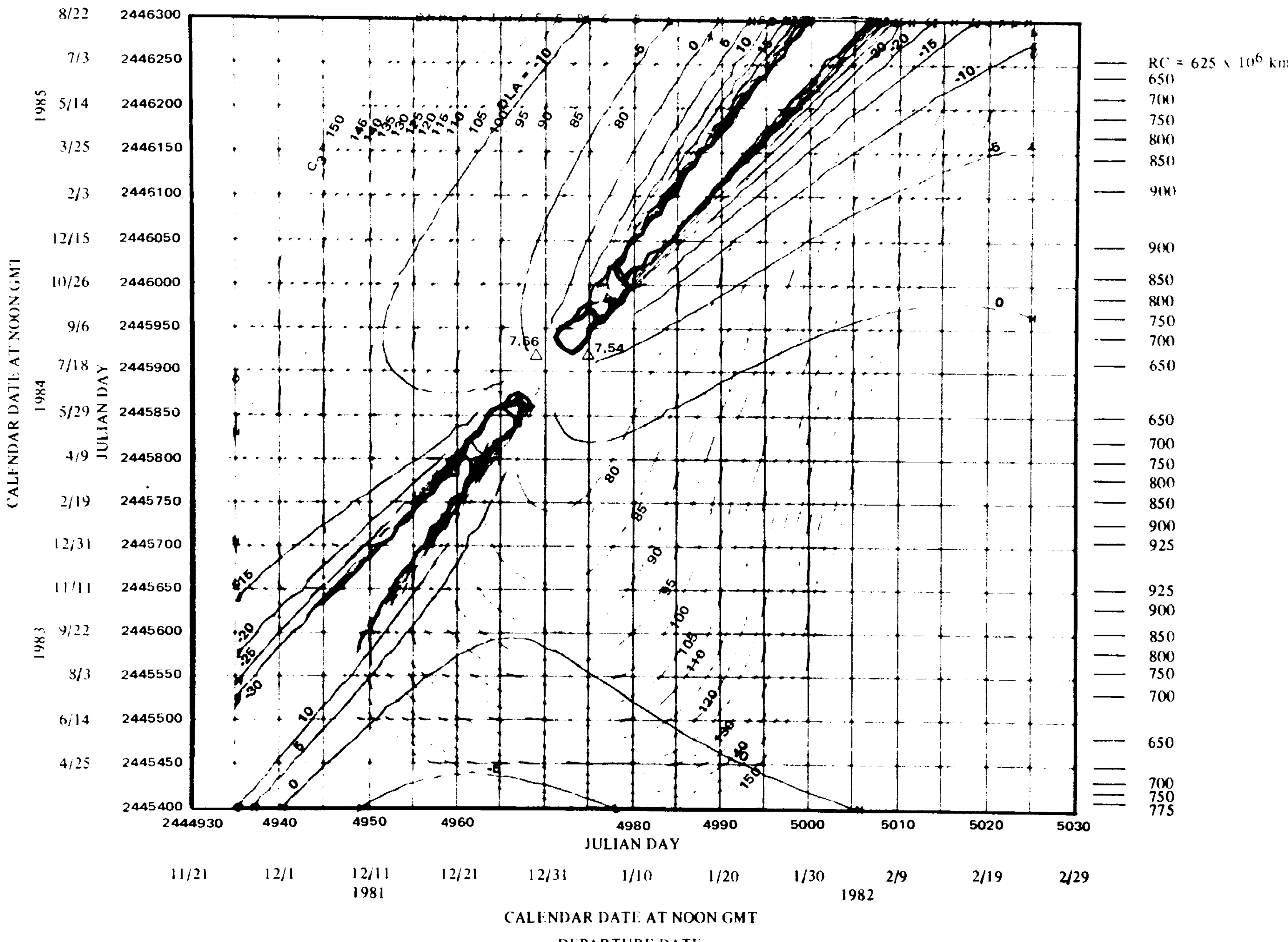

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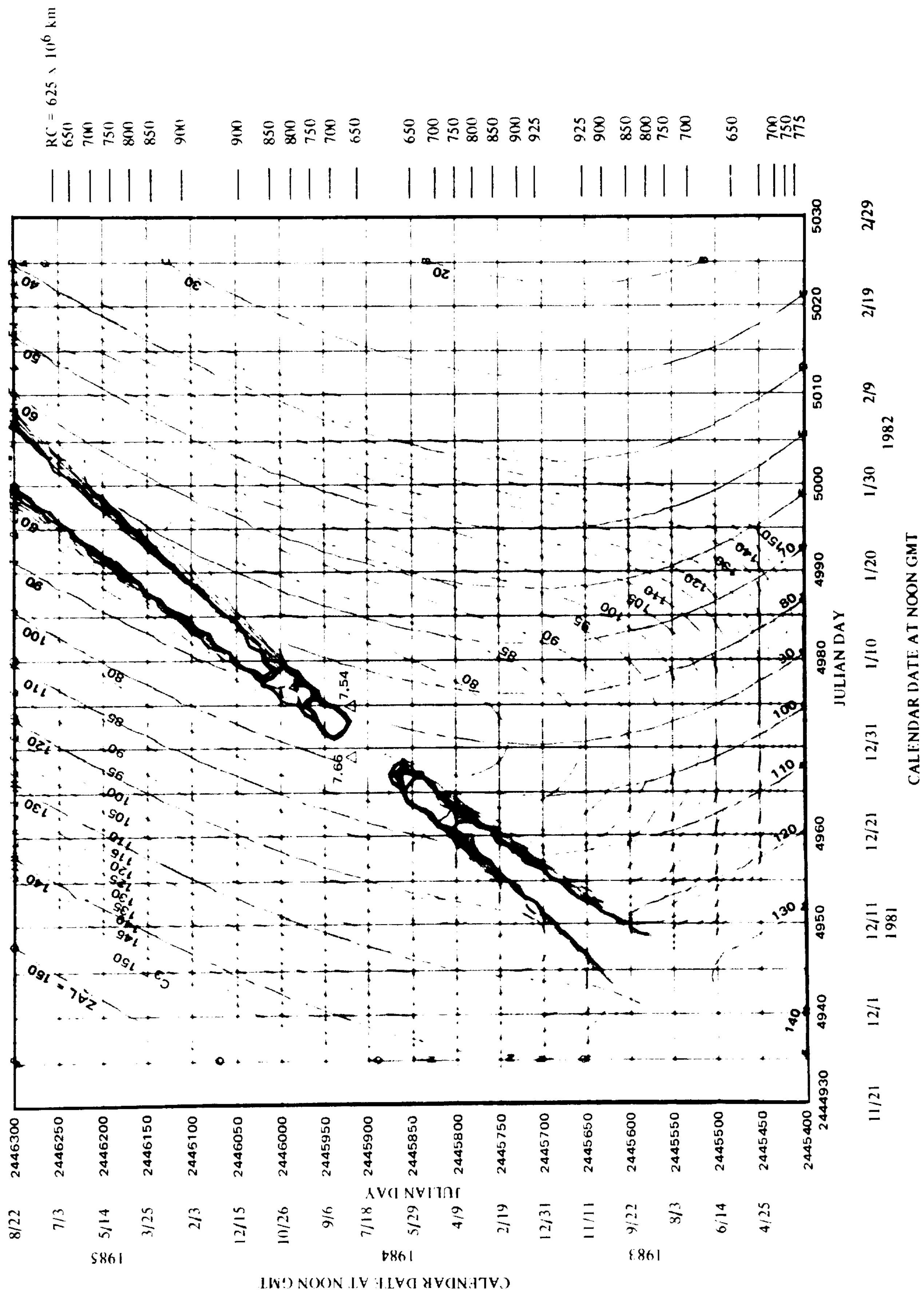

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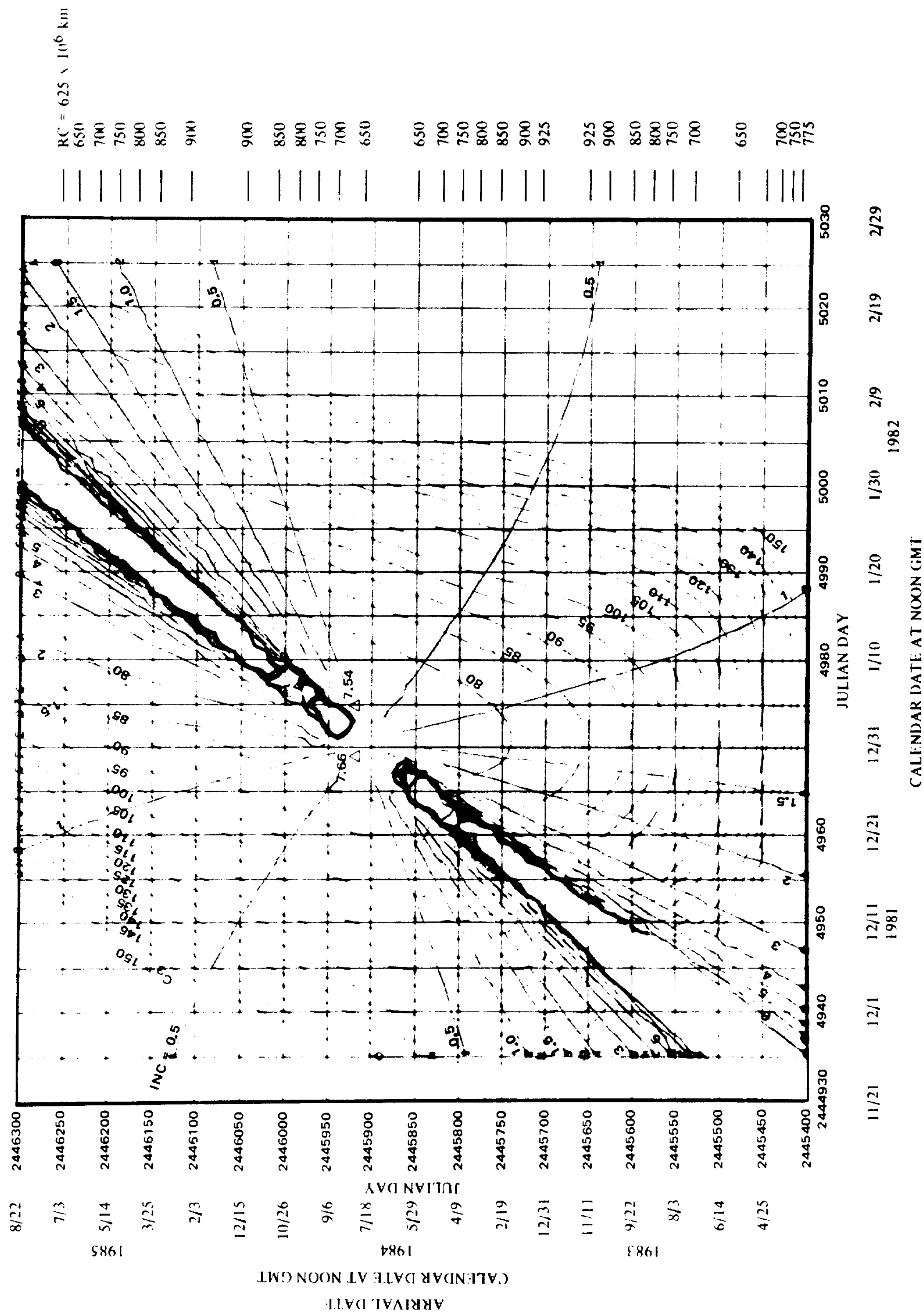

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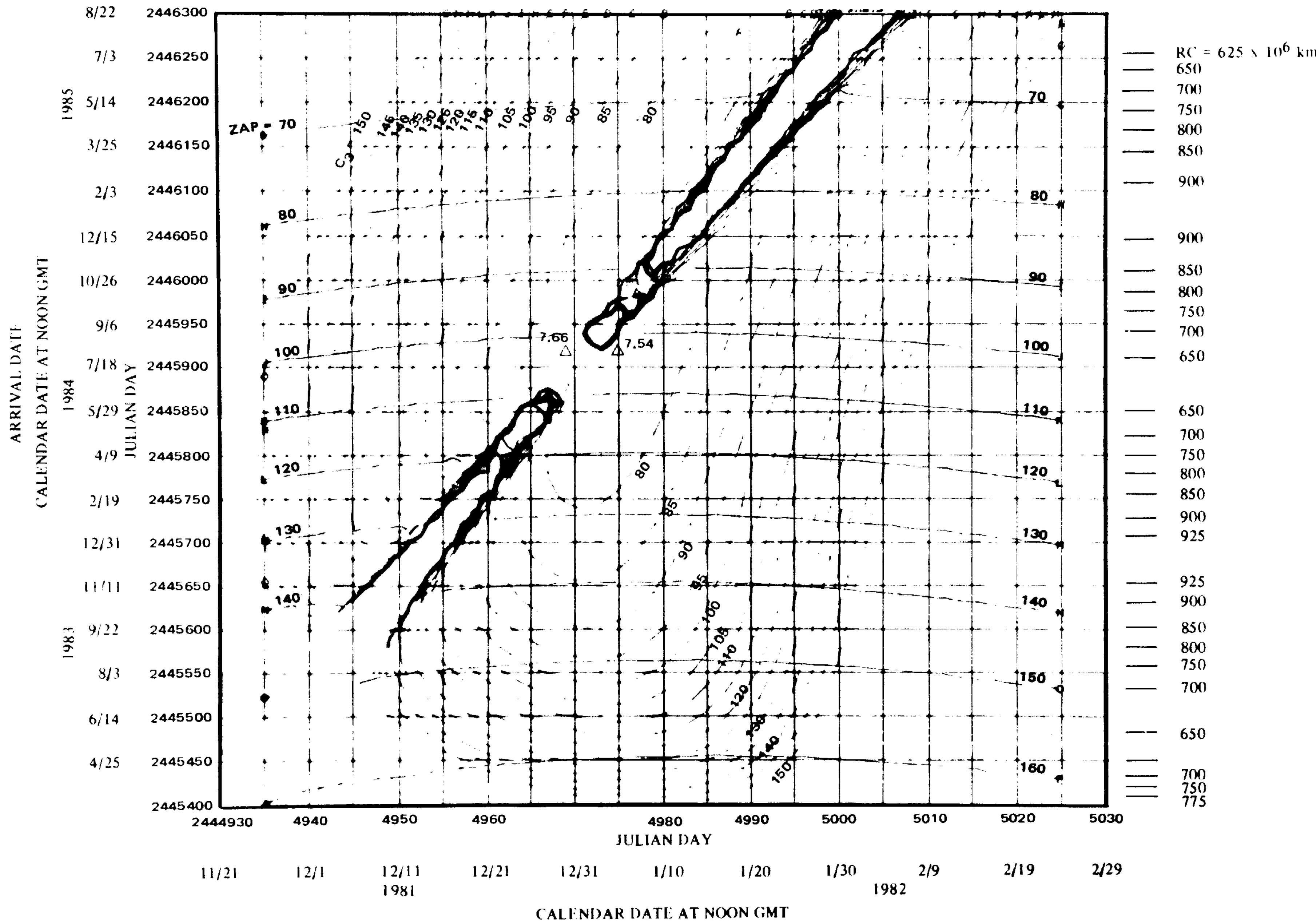

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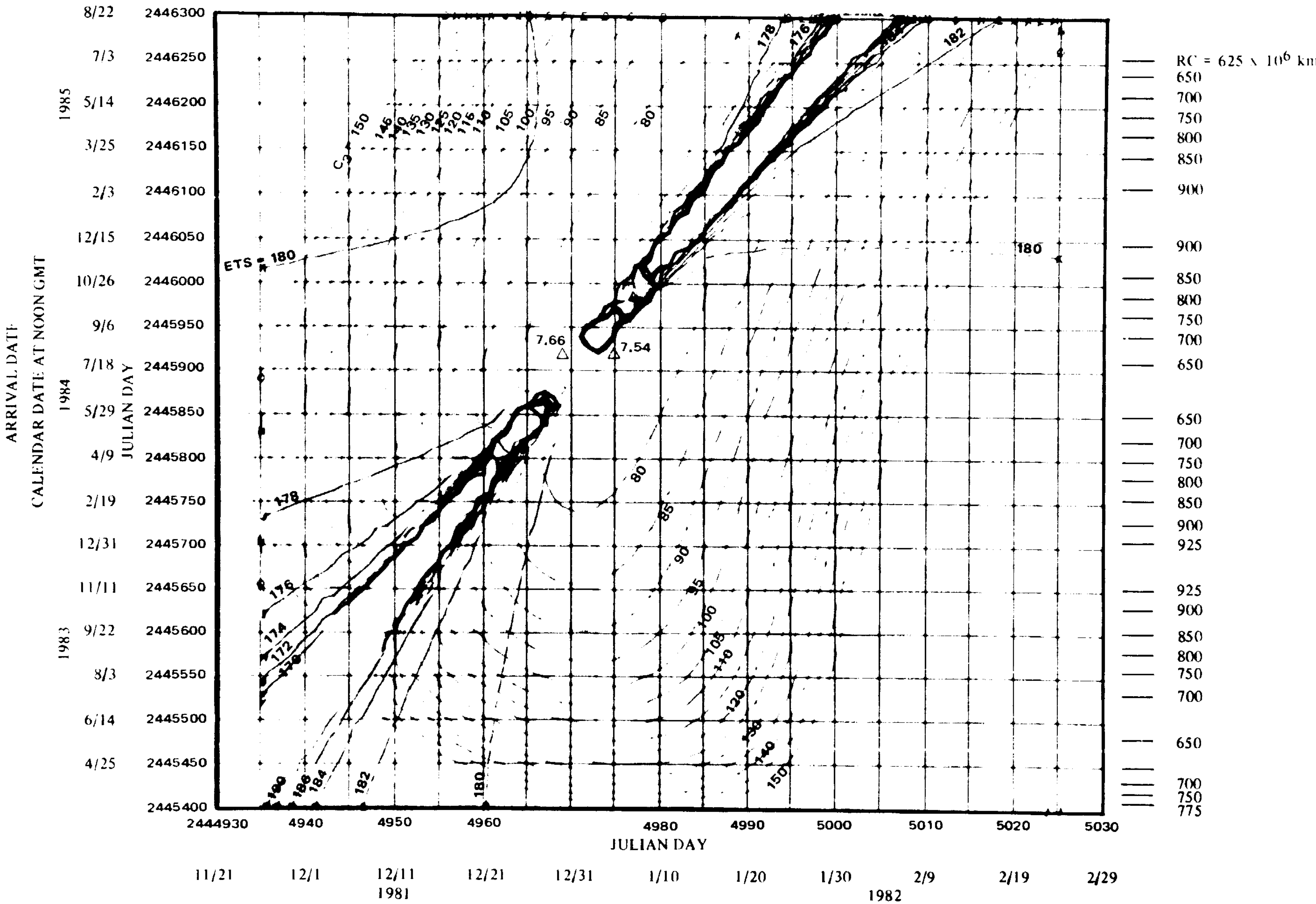

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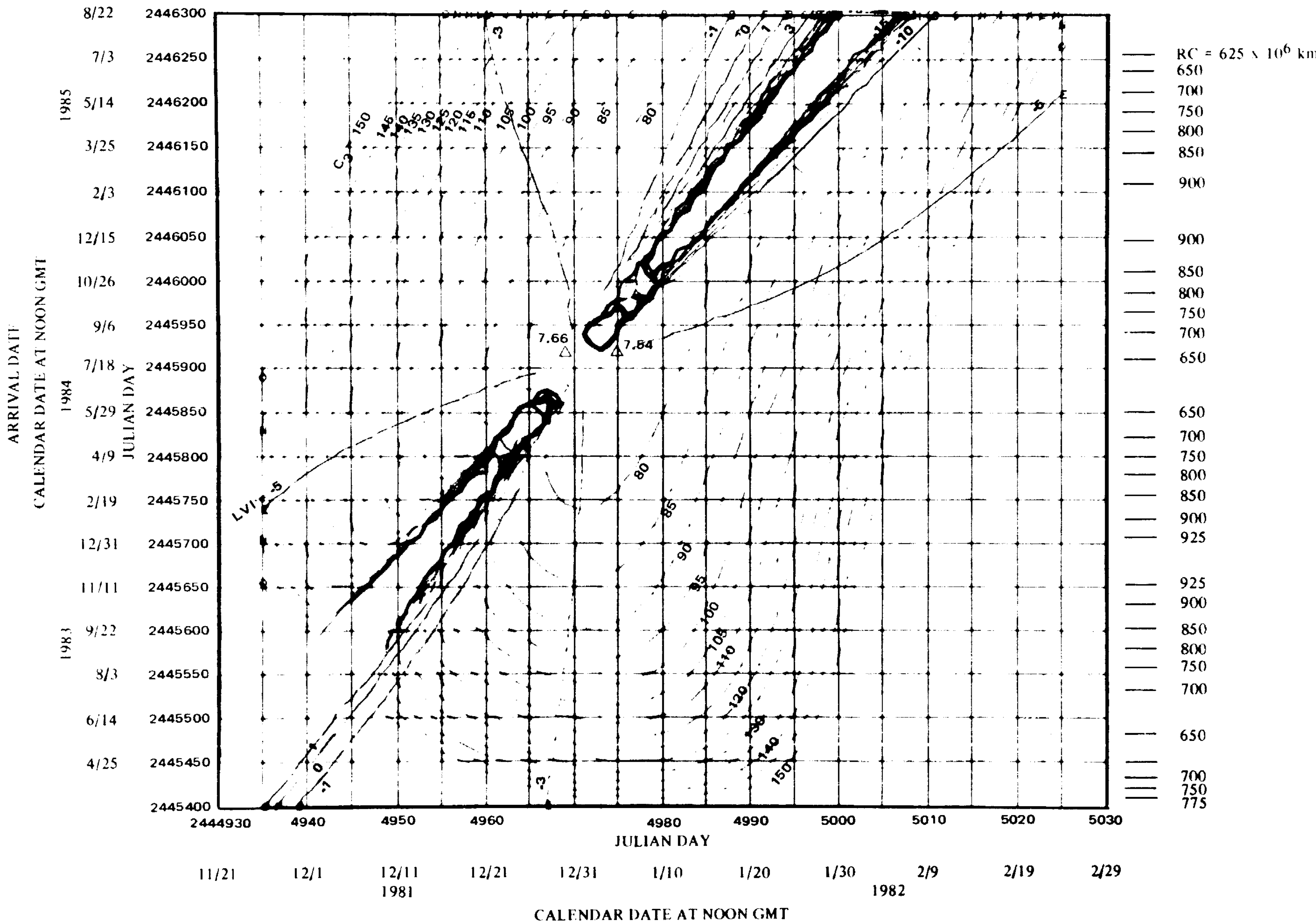

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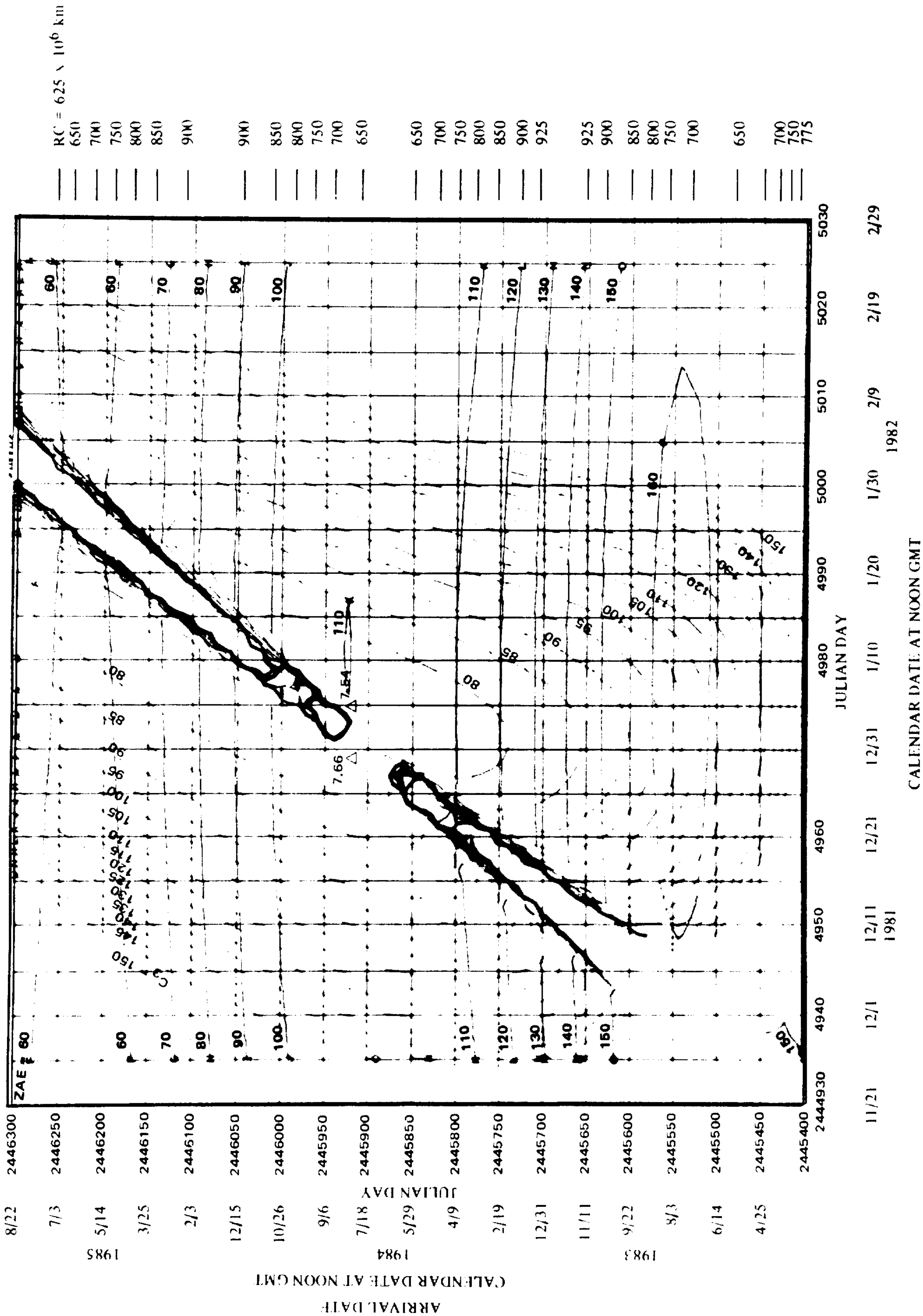

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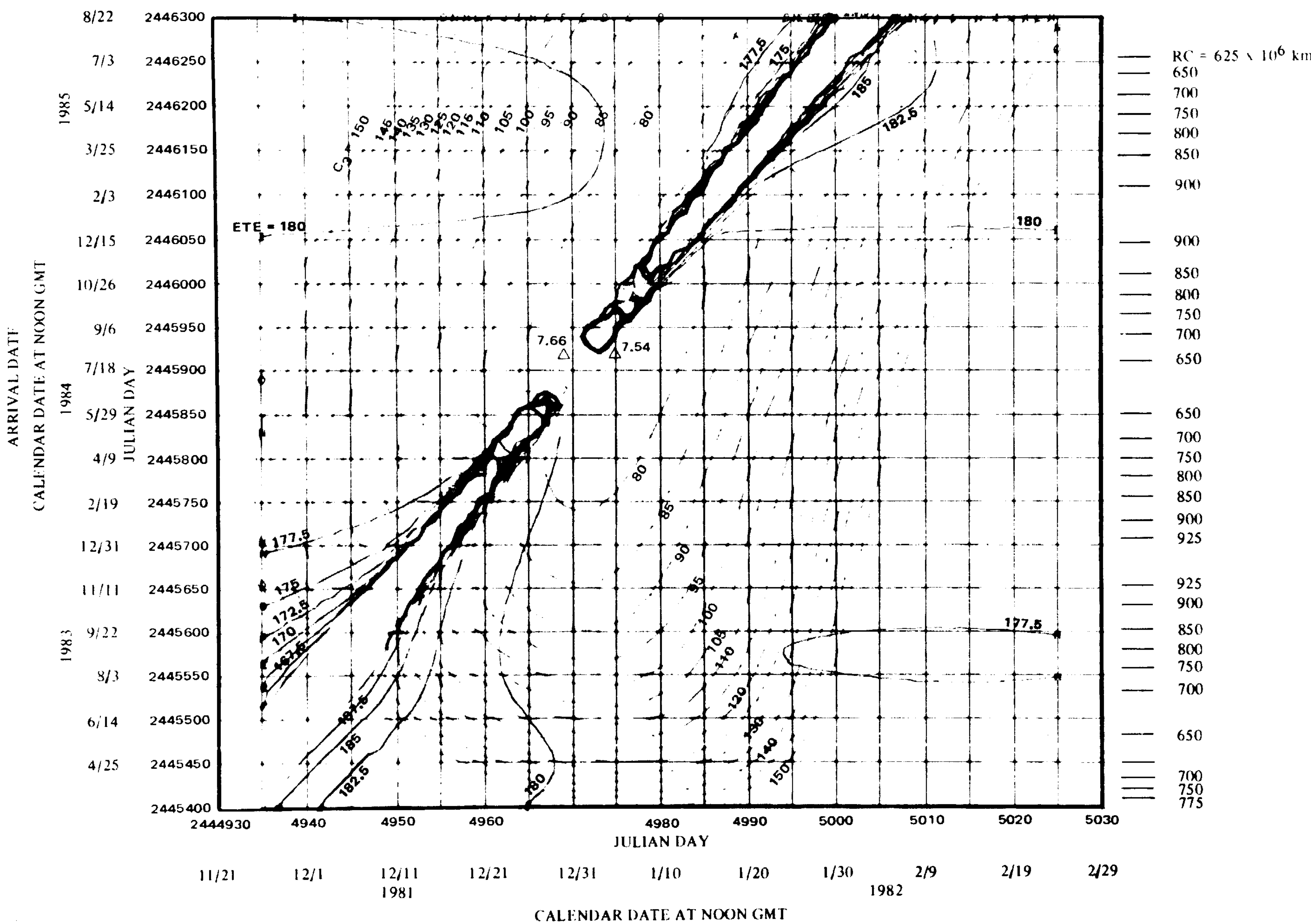

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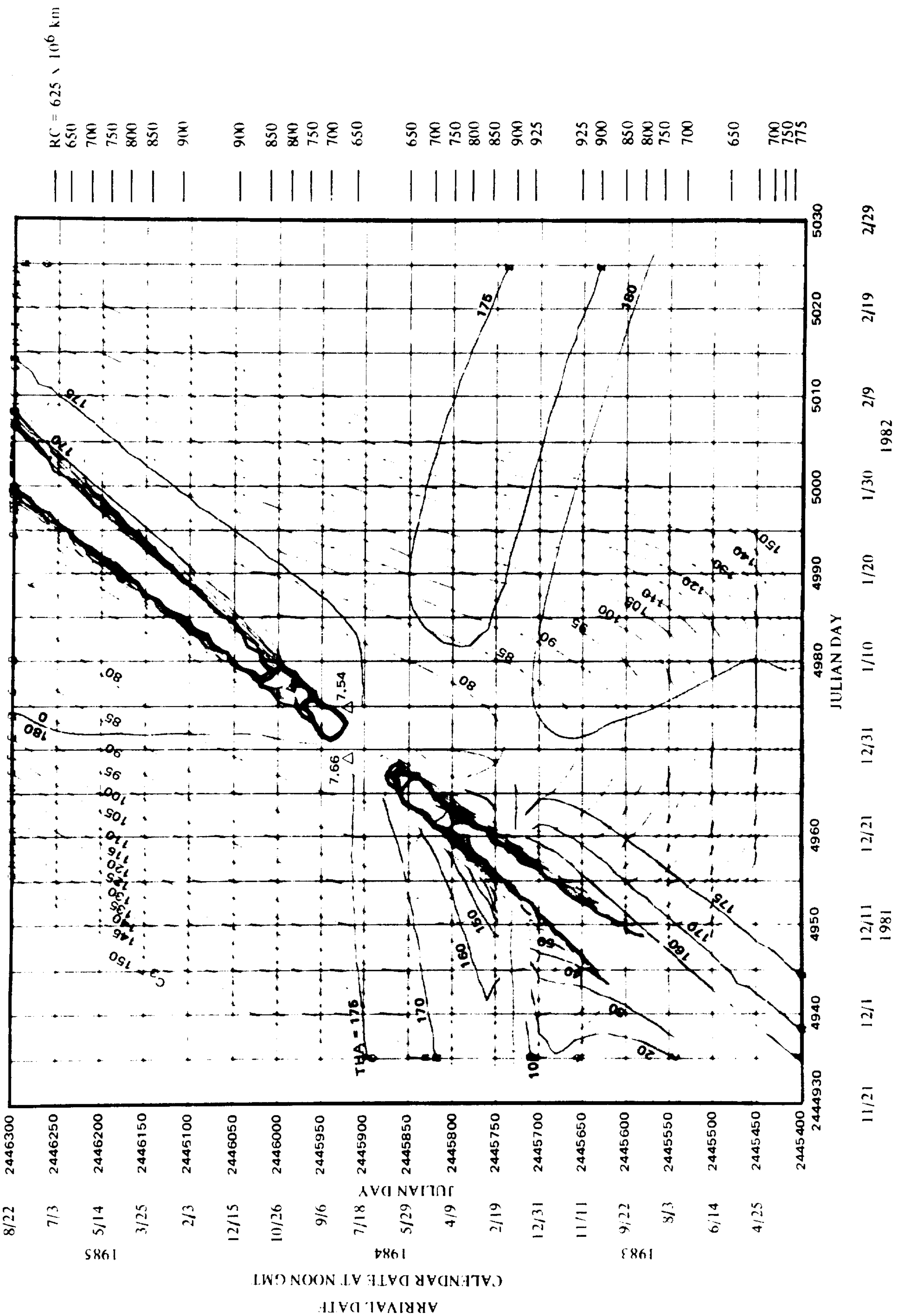

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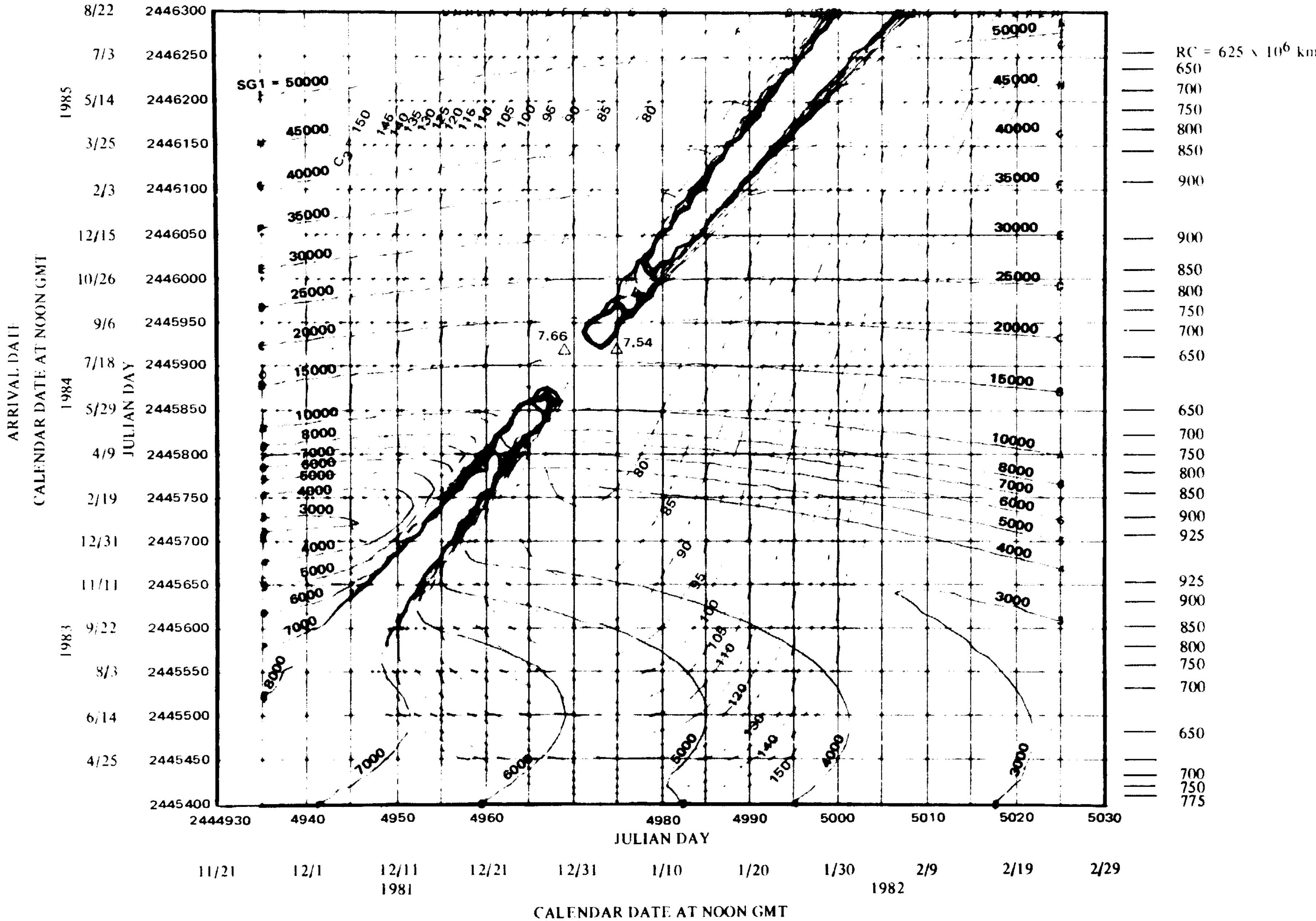

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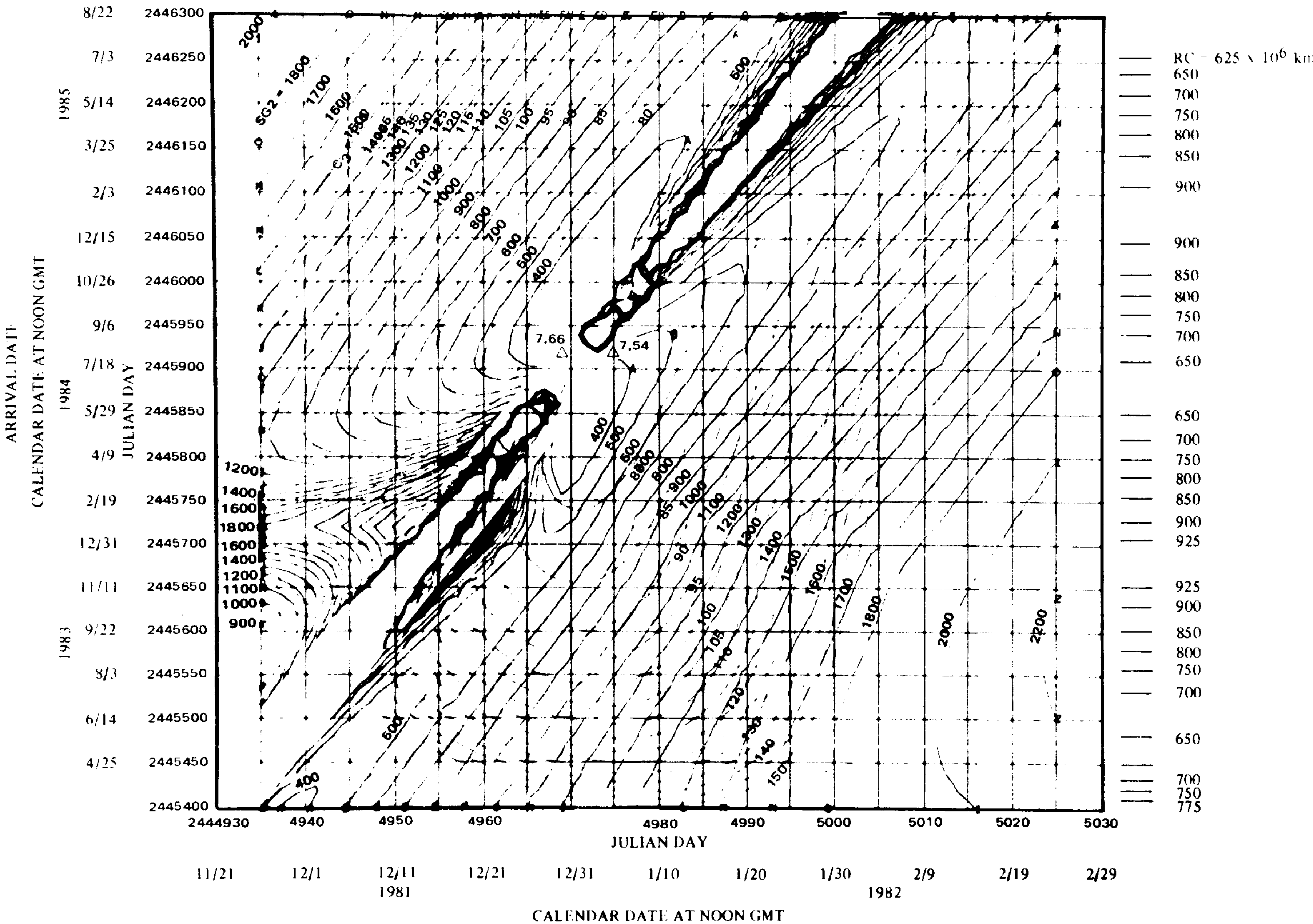

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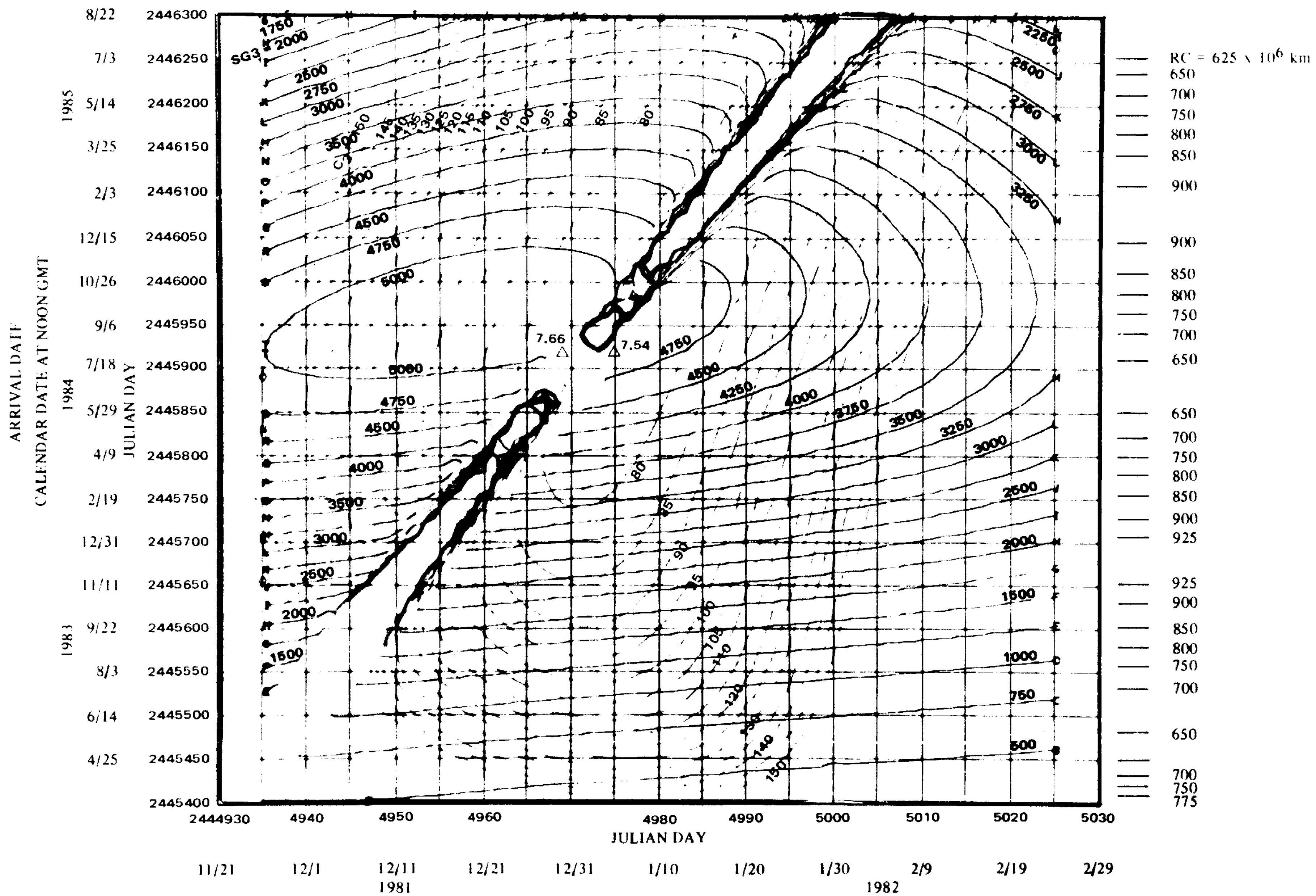
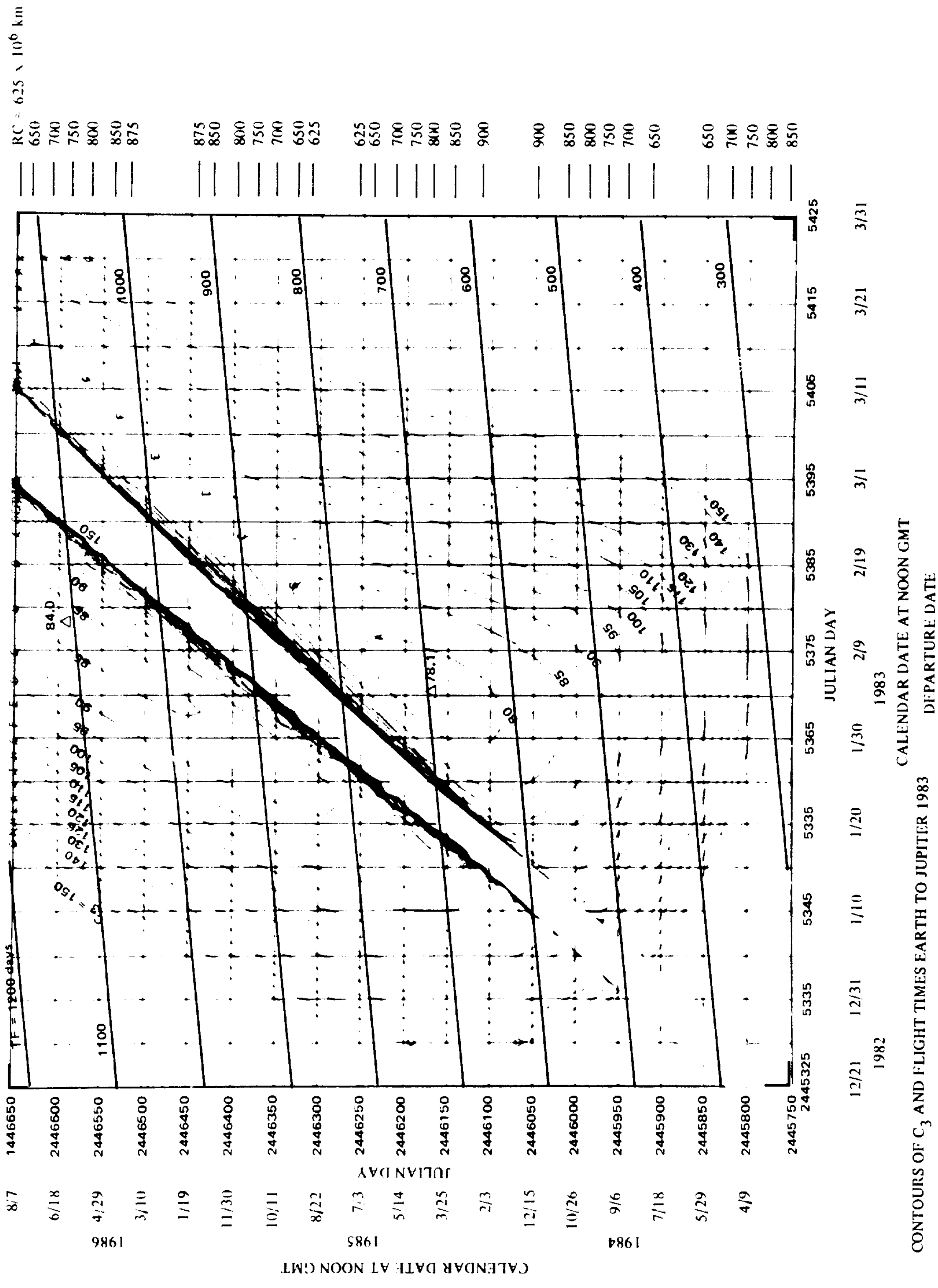
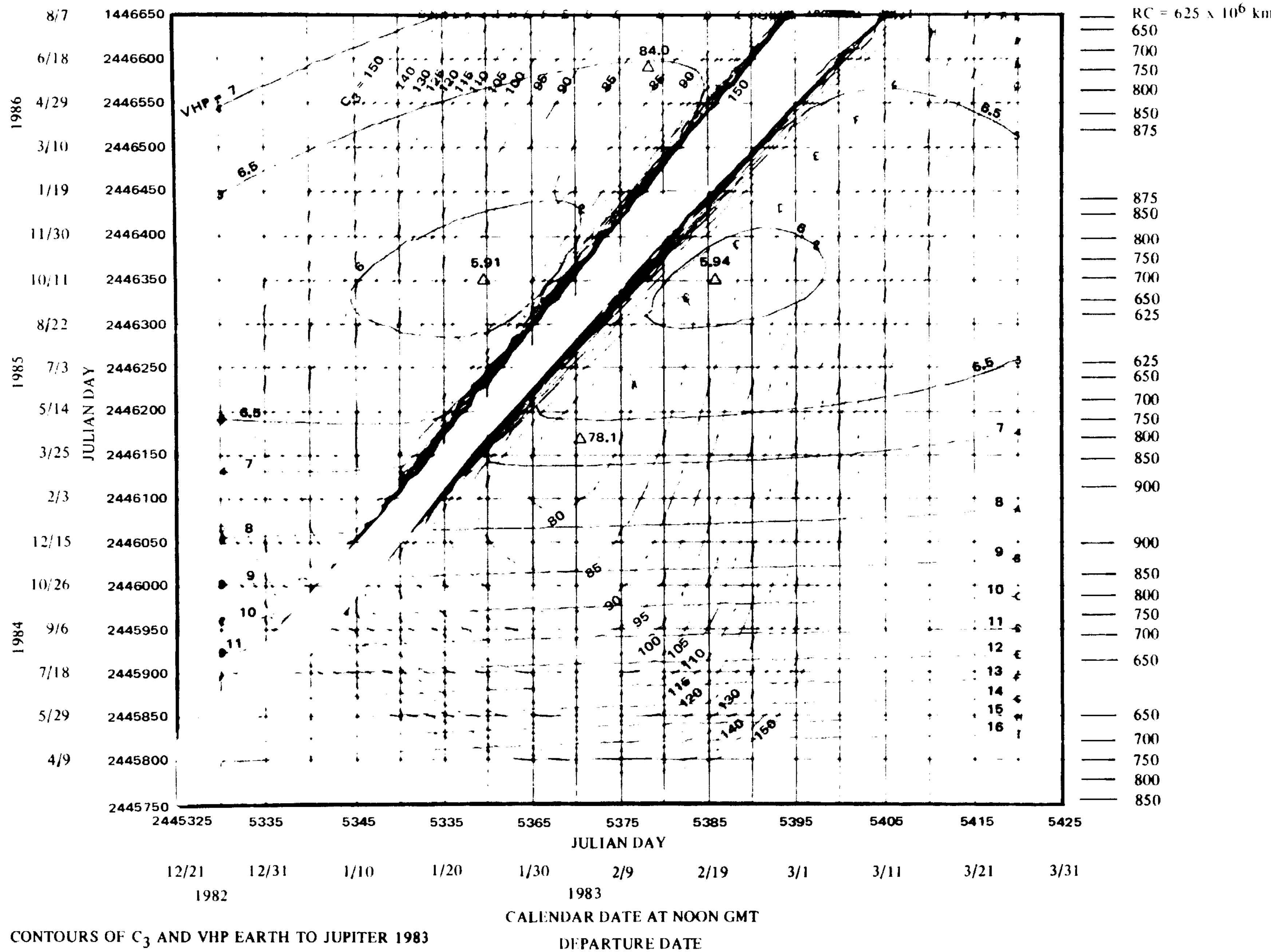


CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1982



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1983



CONTOURS OF C_3 AND VHP EARTH TO JUPITER 1983

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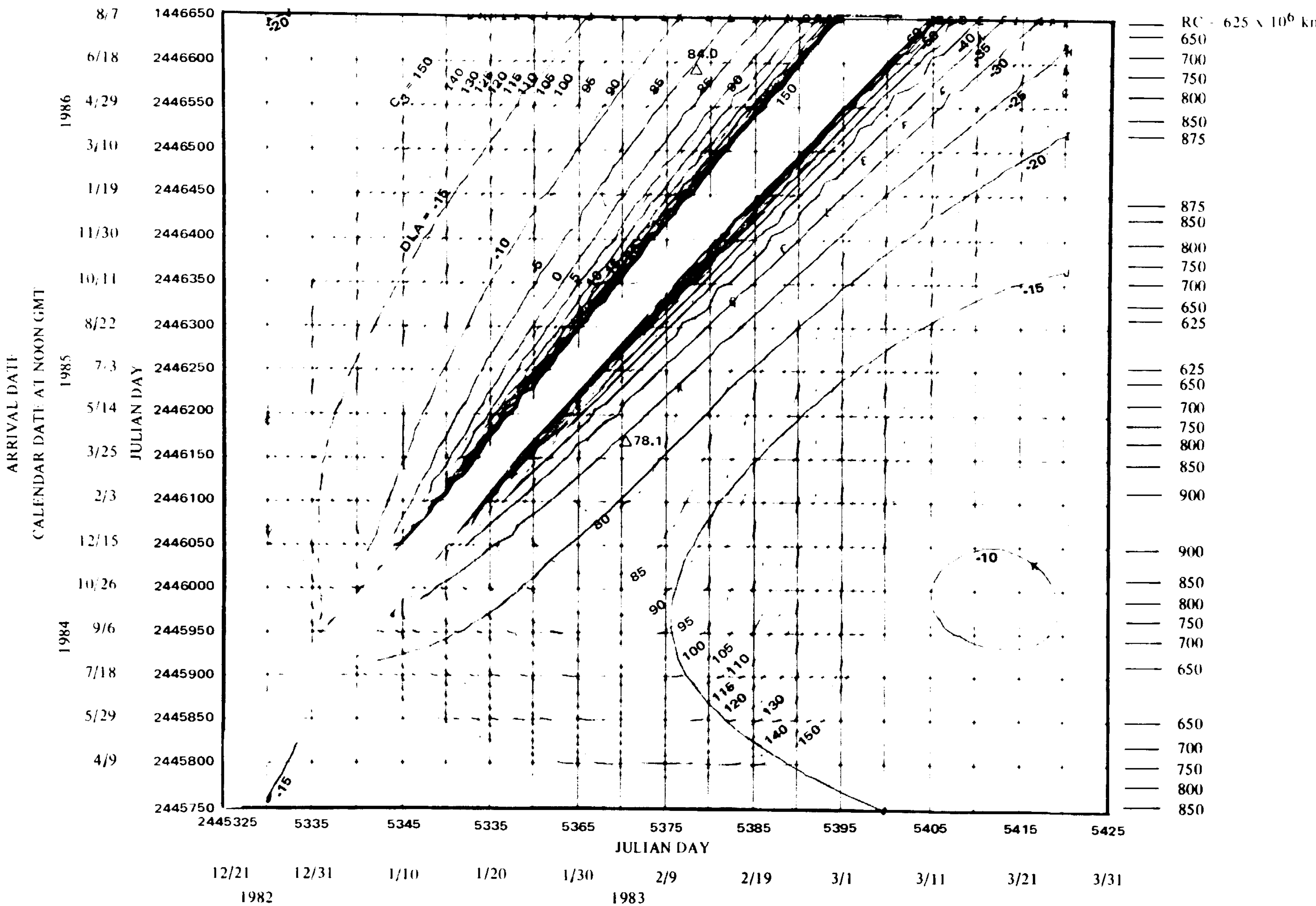

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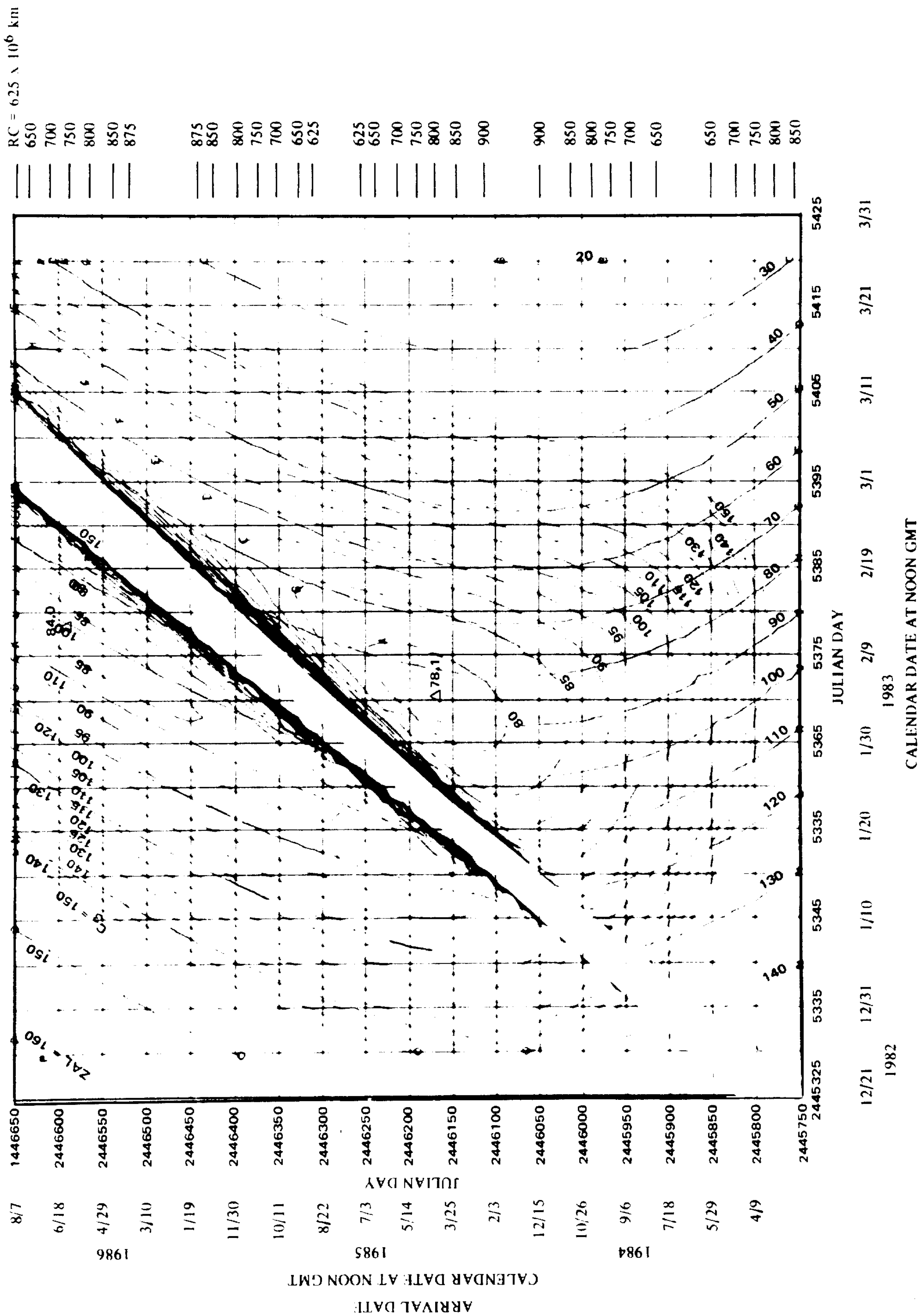

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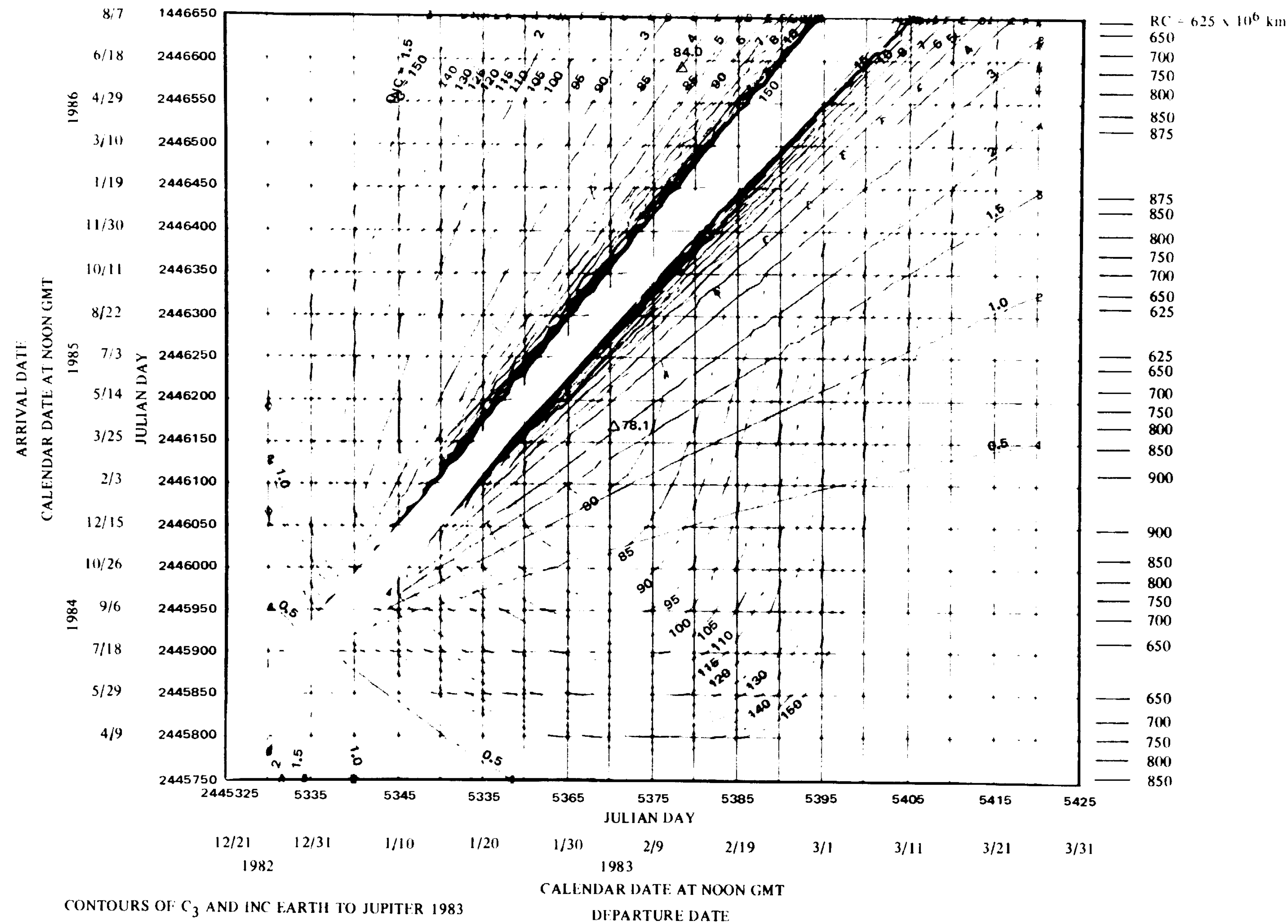

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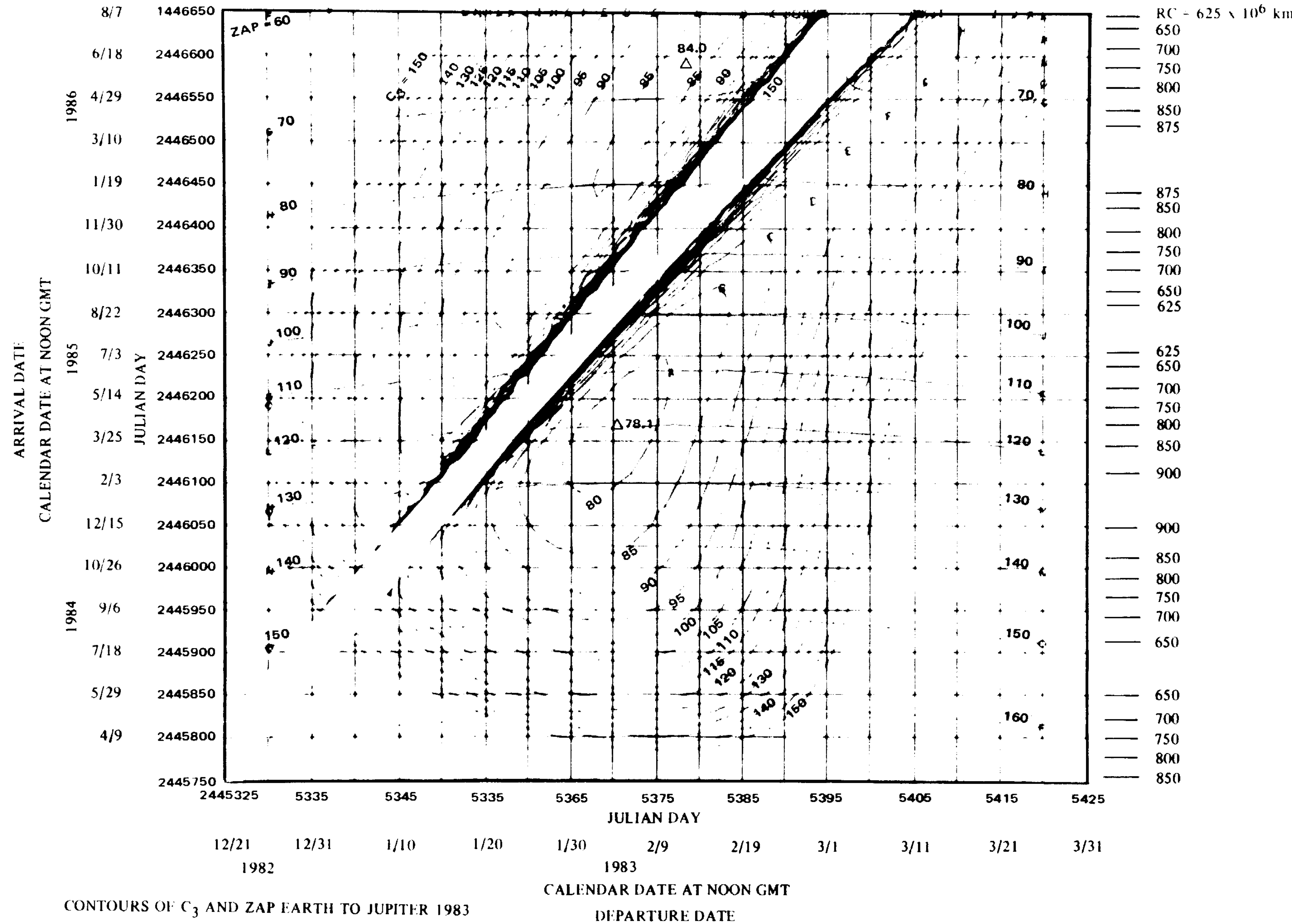

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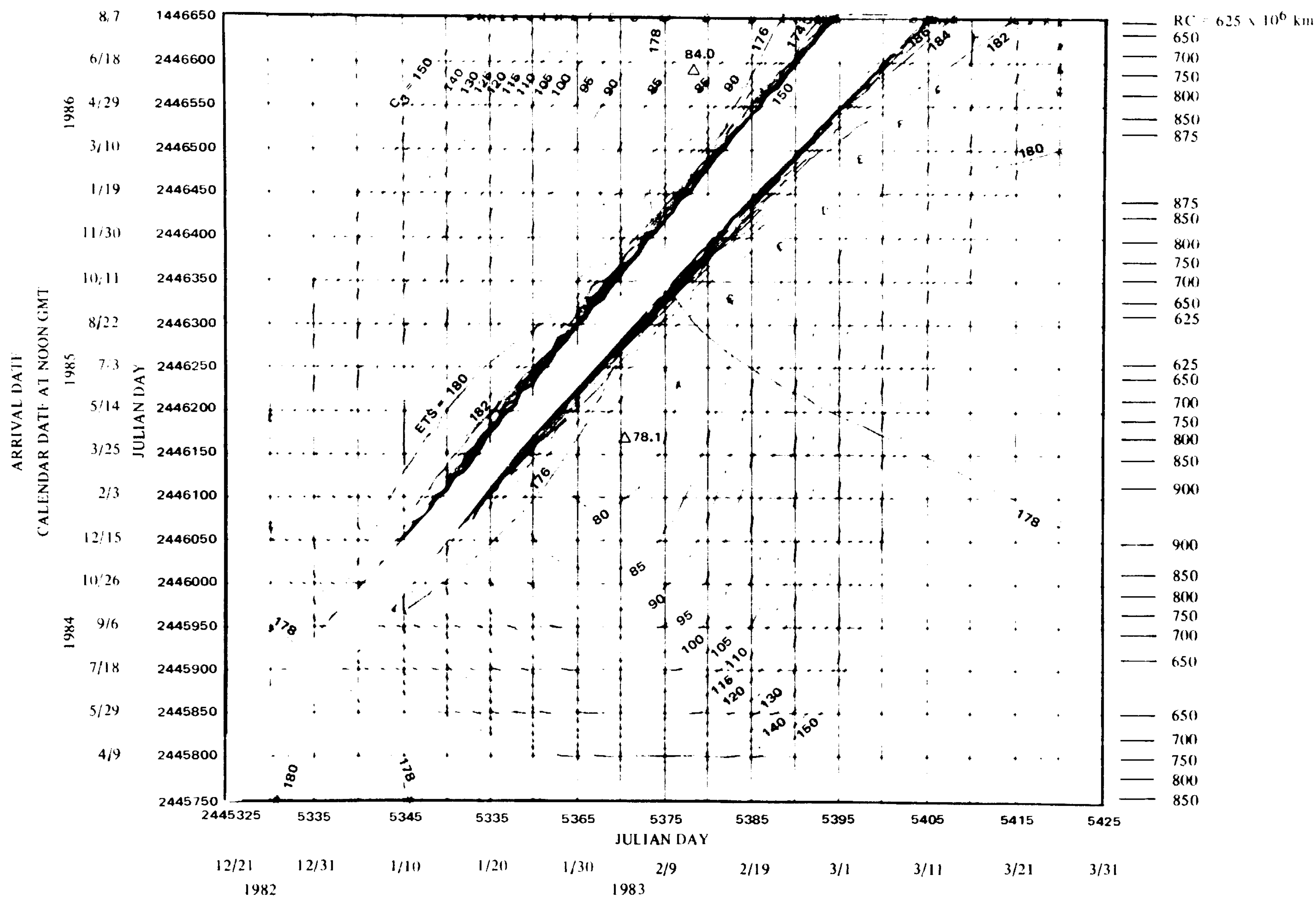

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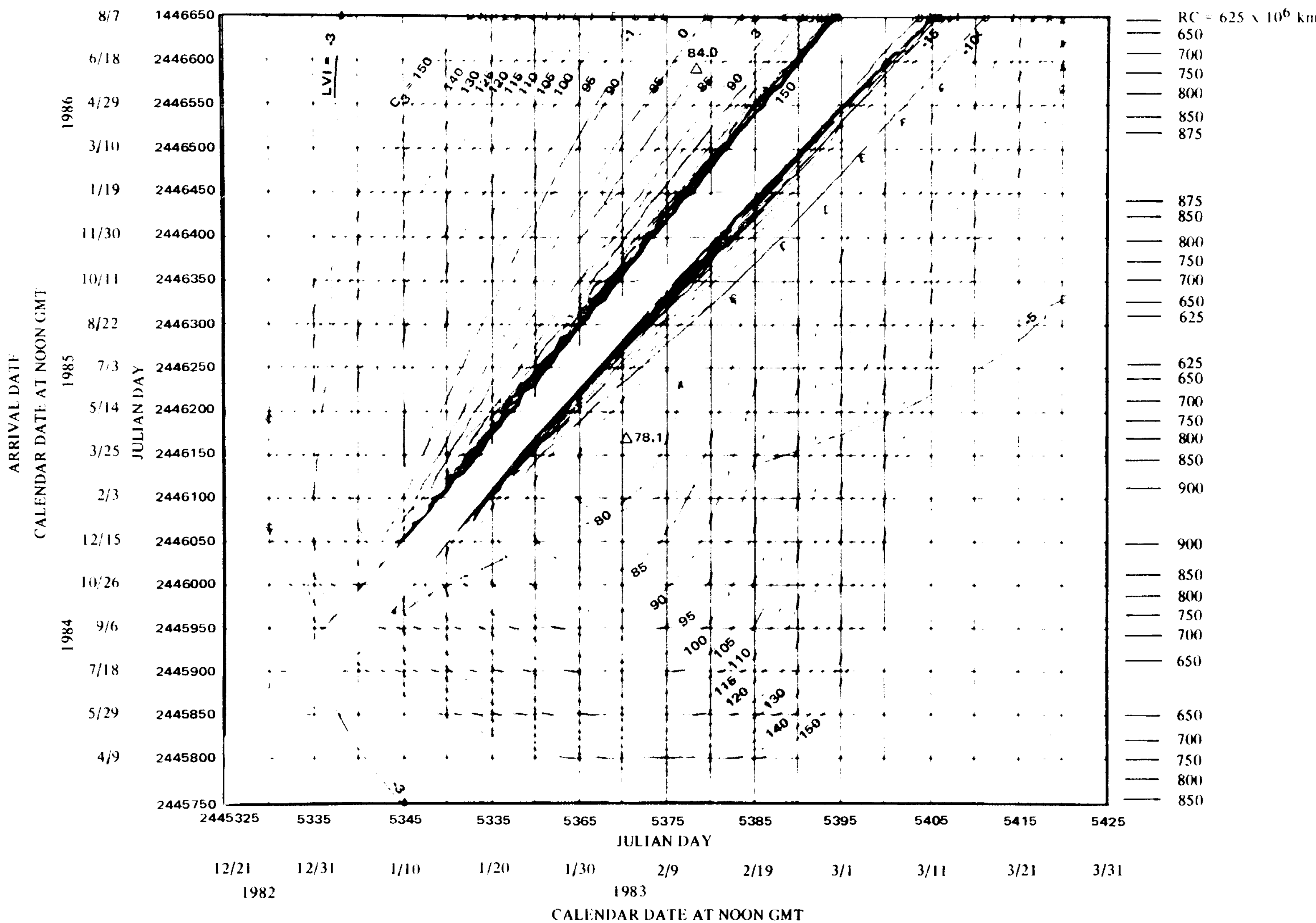

CONTOURS OF C_3 AND LVI EARTH TO JUPITER 1983

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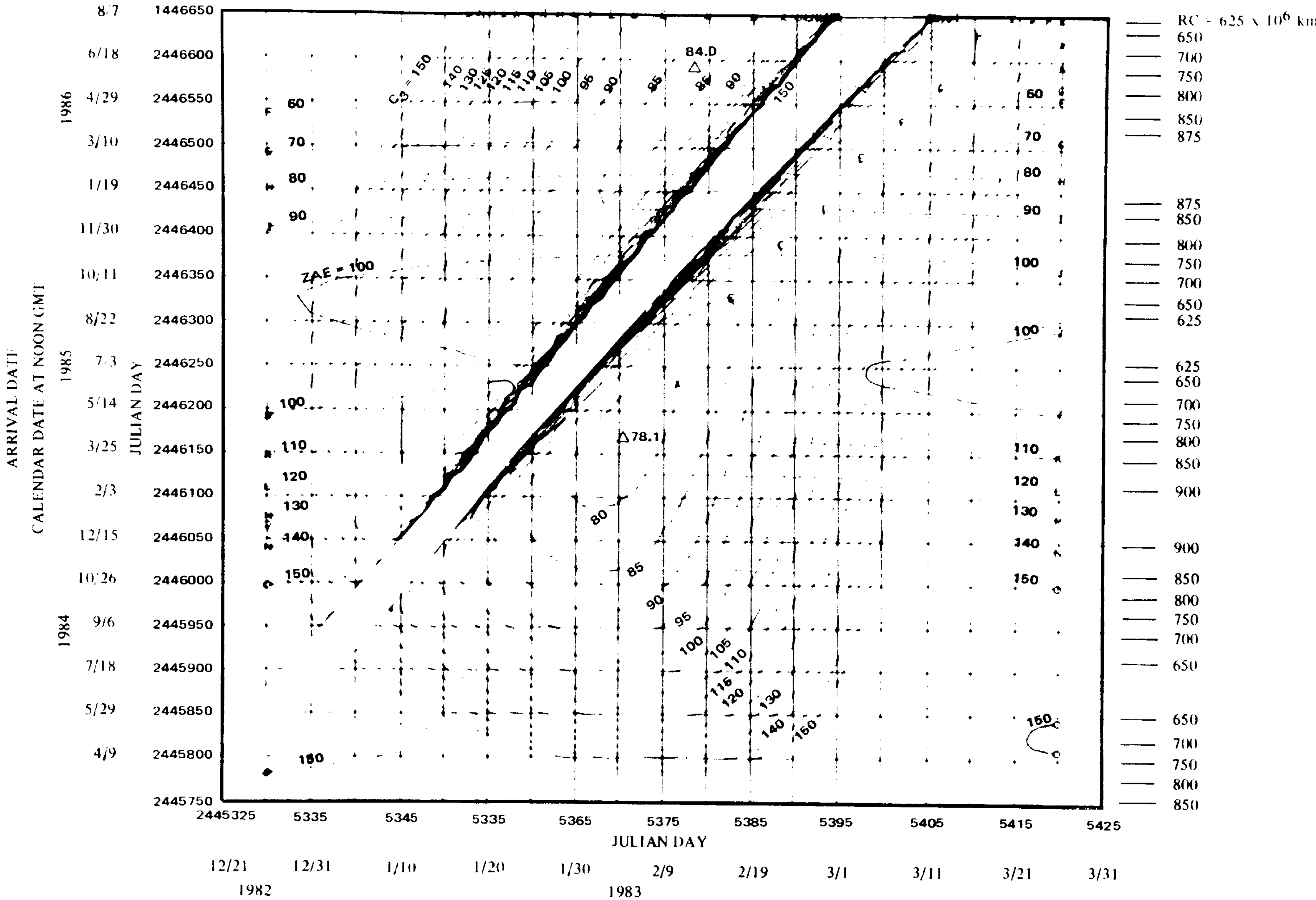

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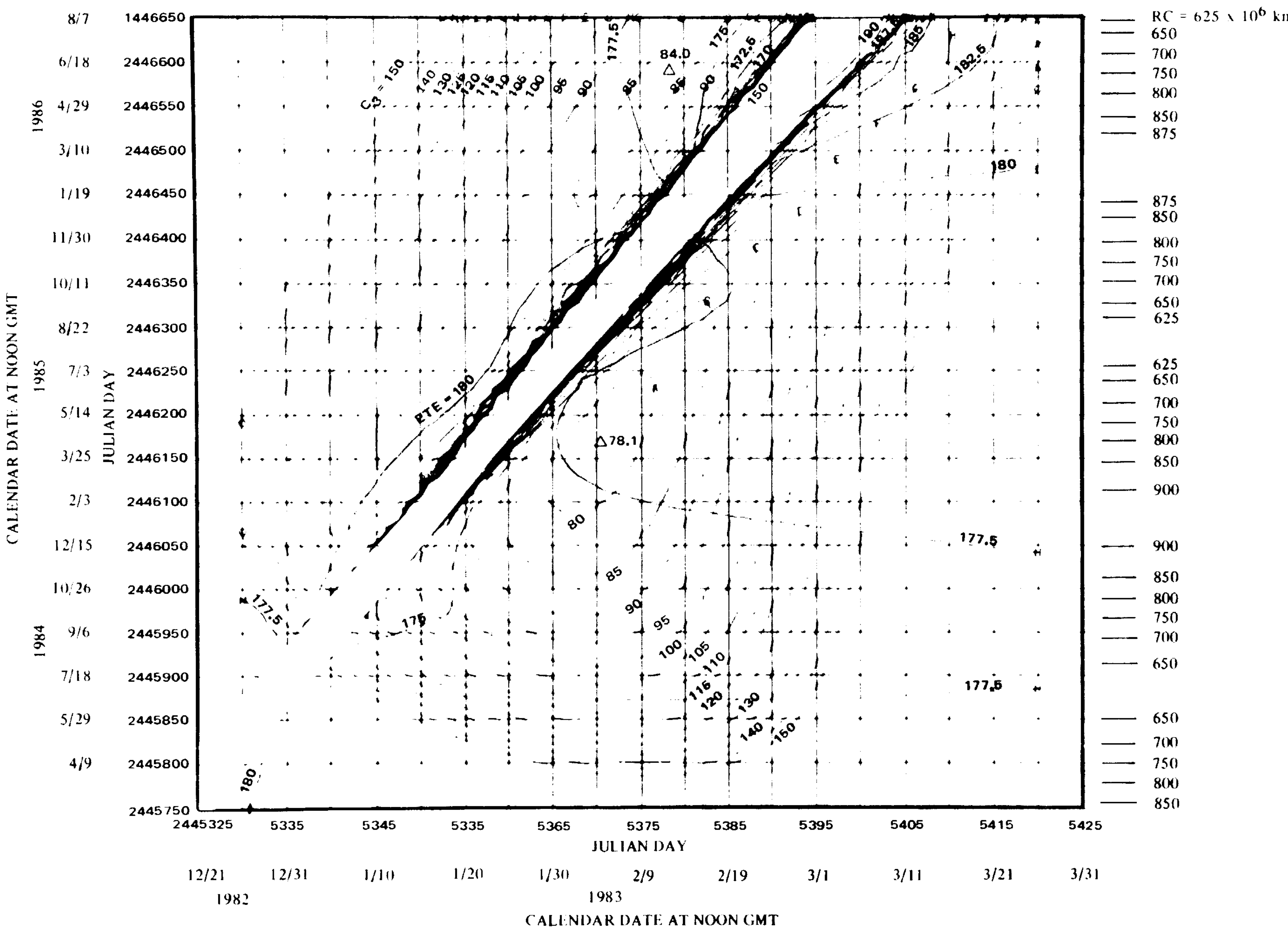
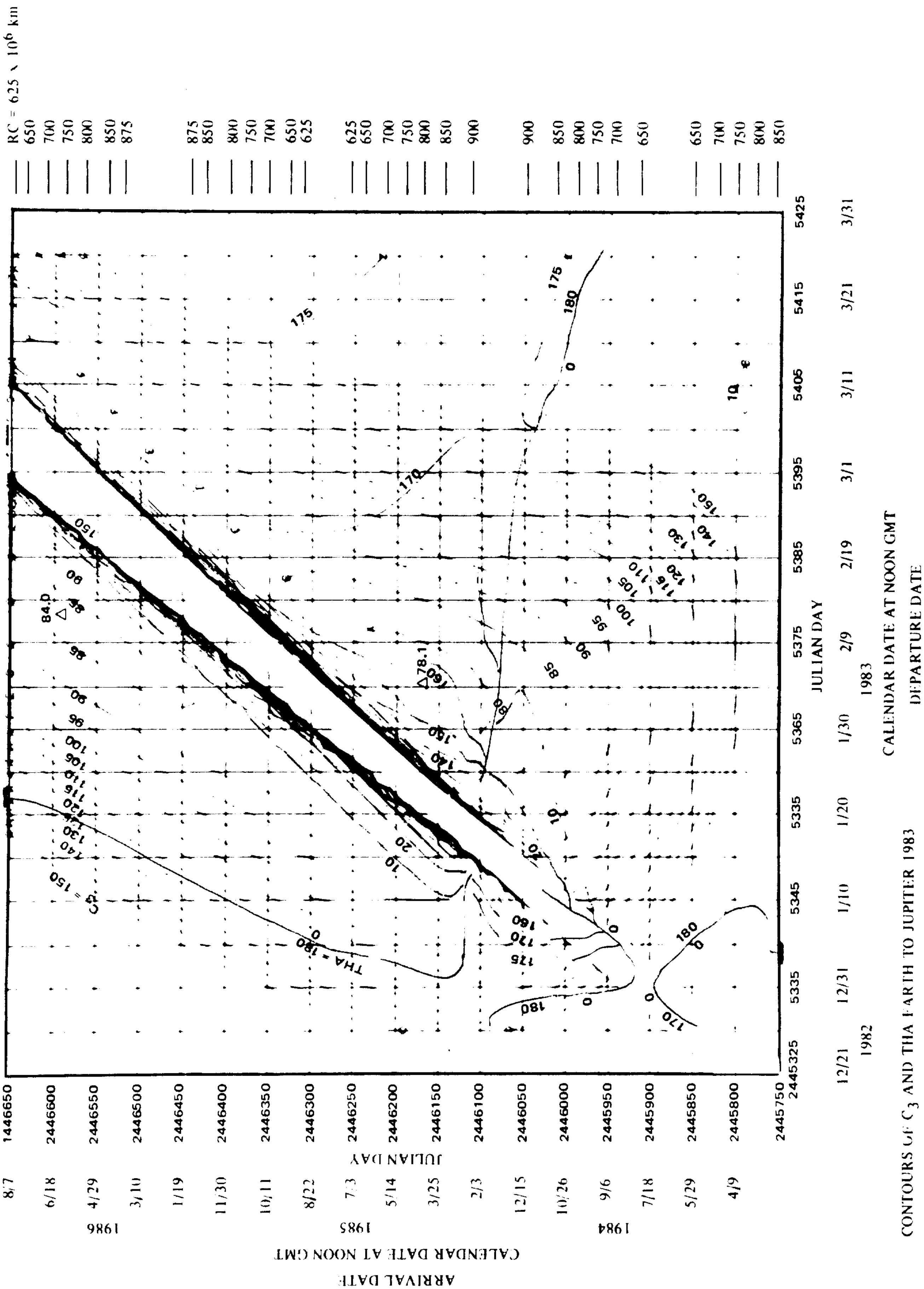


CONTOURS OF C_3 AND ETE EARTH TO JUPITER 1983



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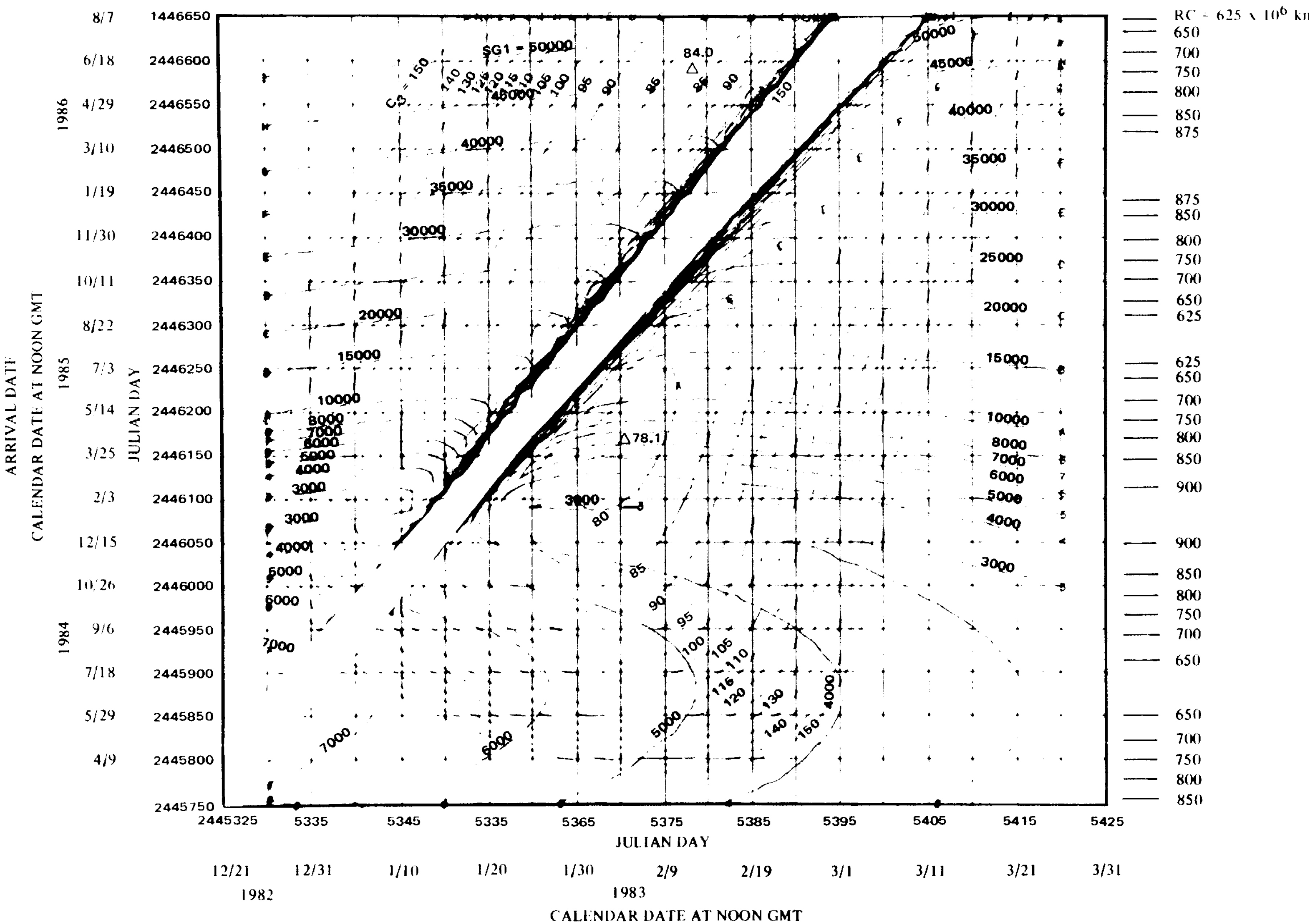
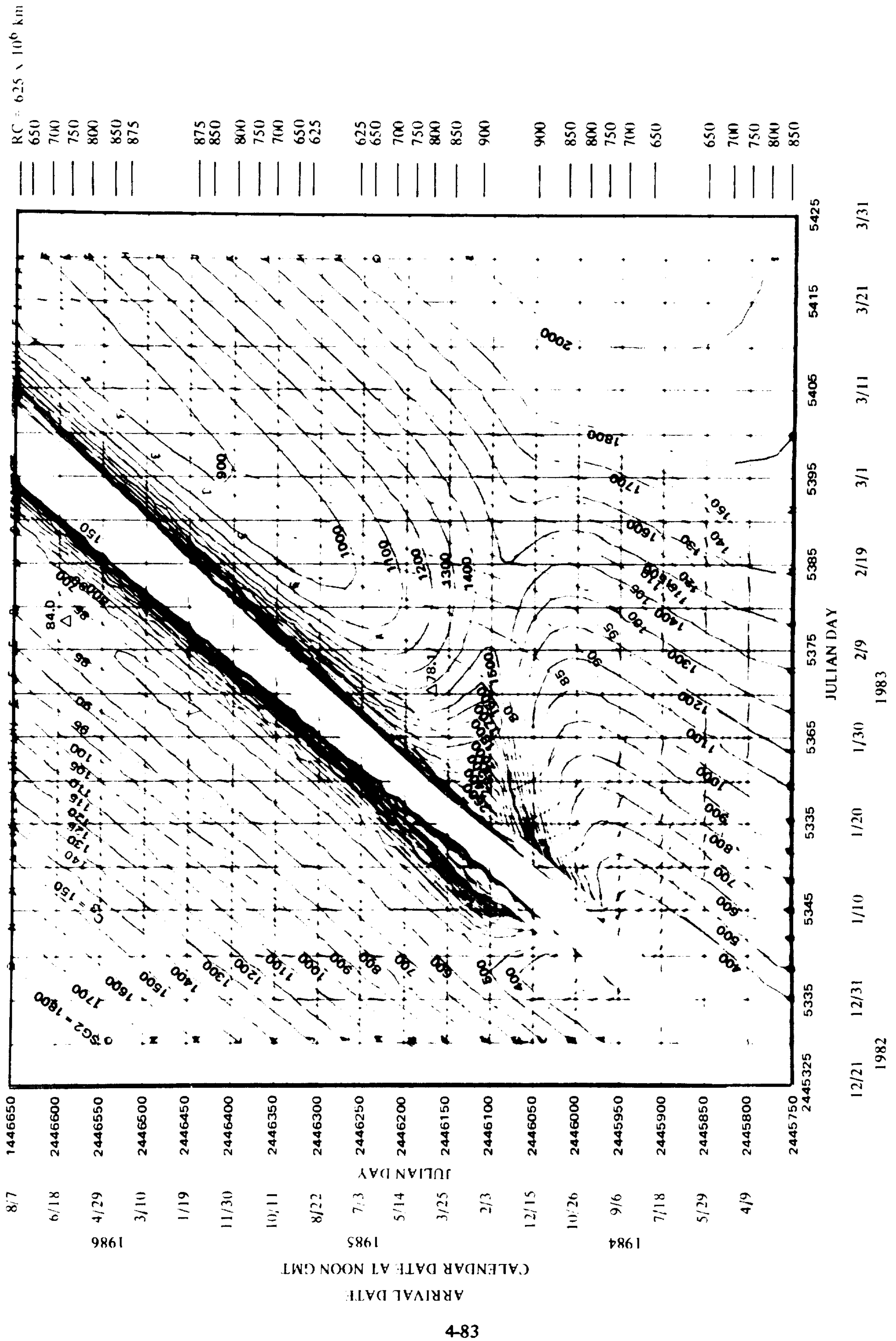


CONTOURS OF C_3 AND SG1 EARTH TO JUPITER 1983



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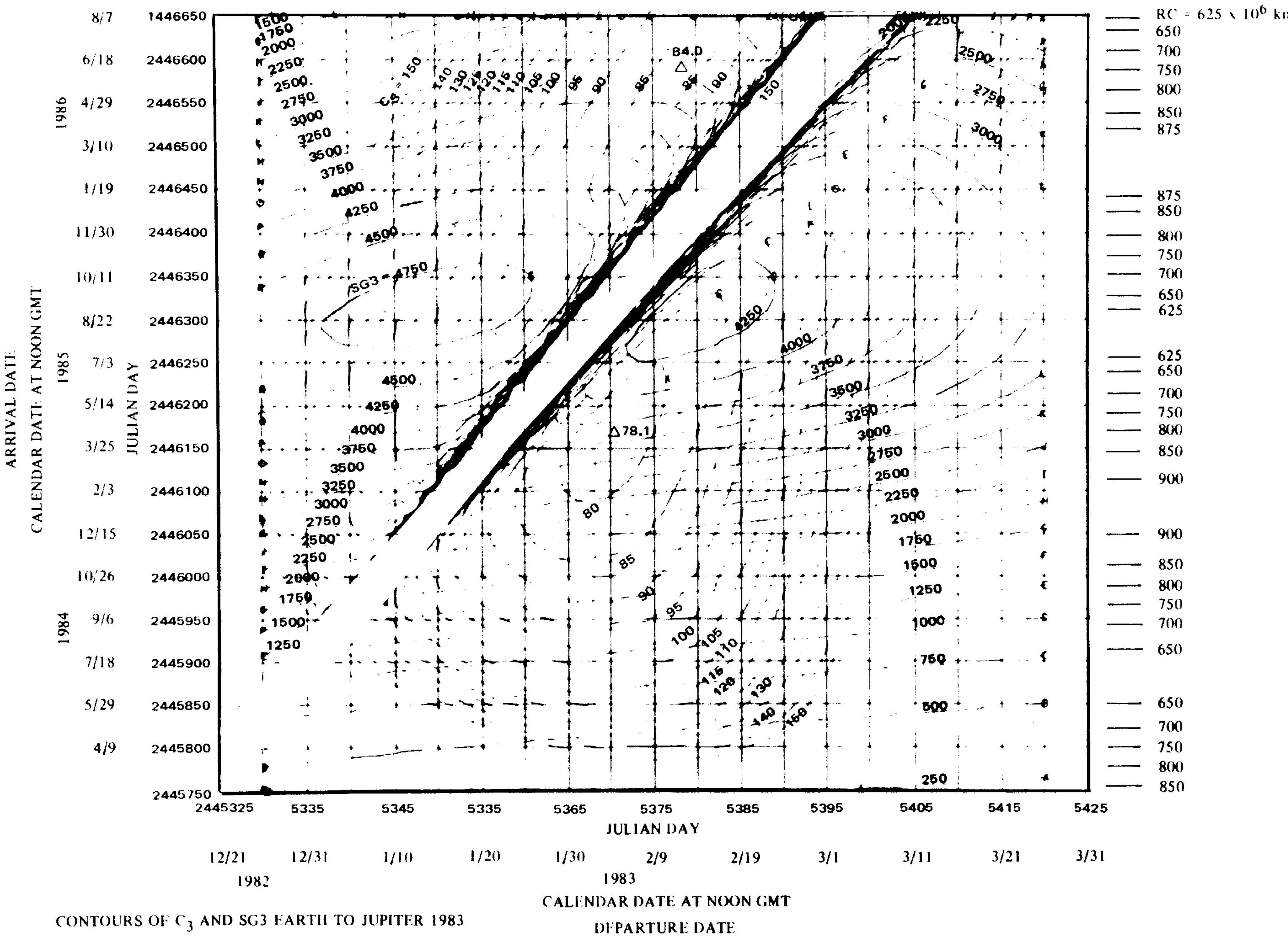
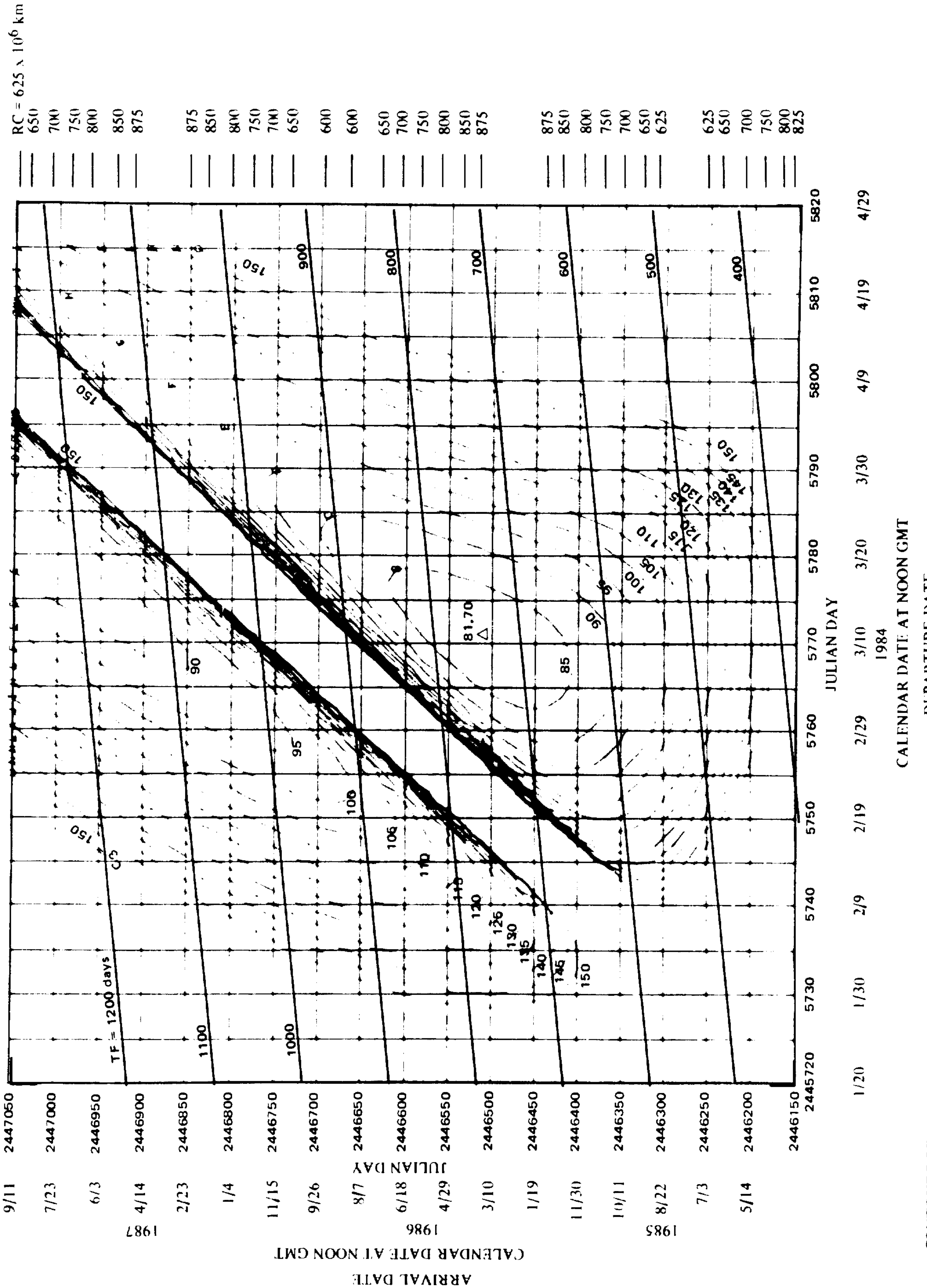
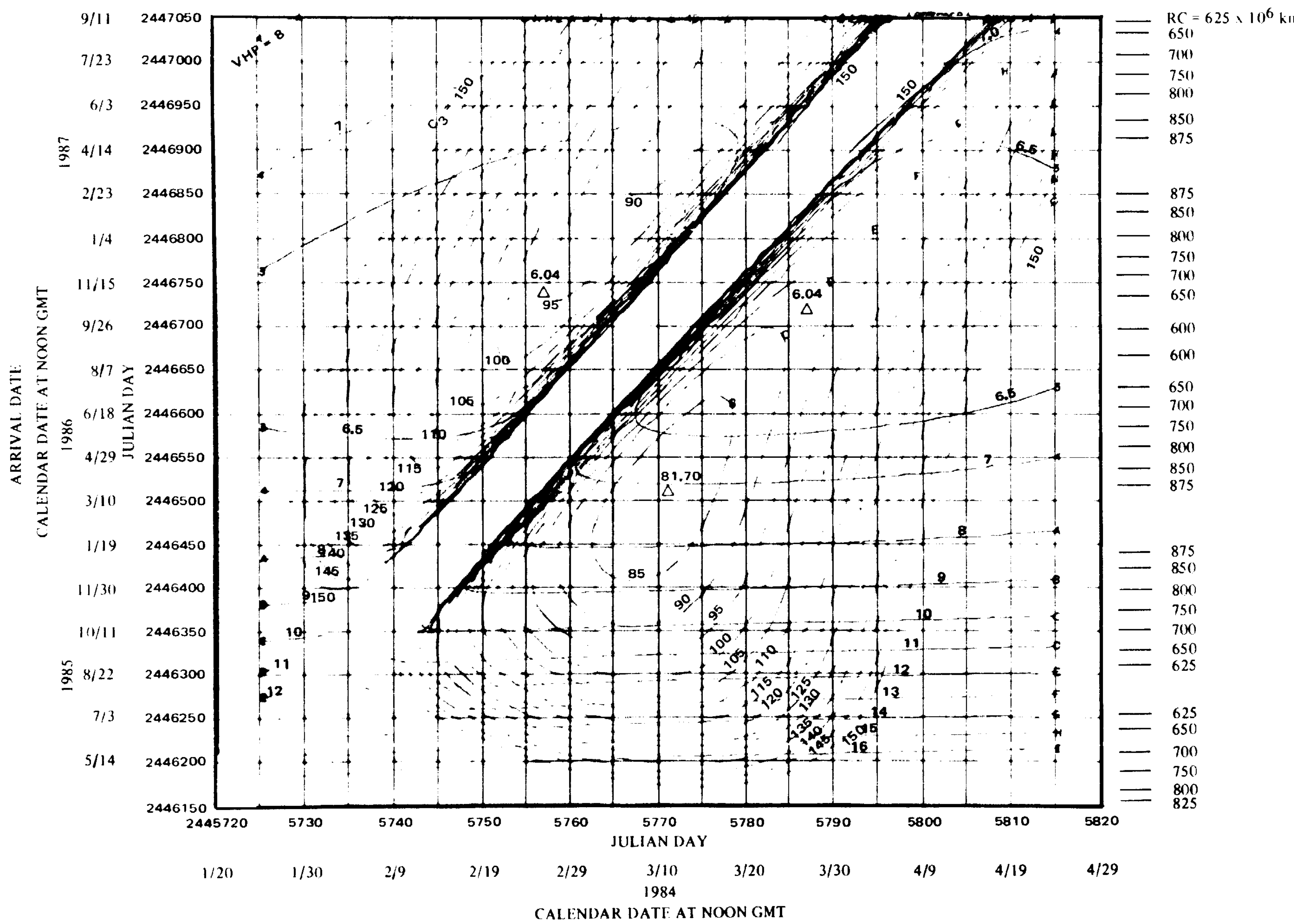


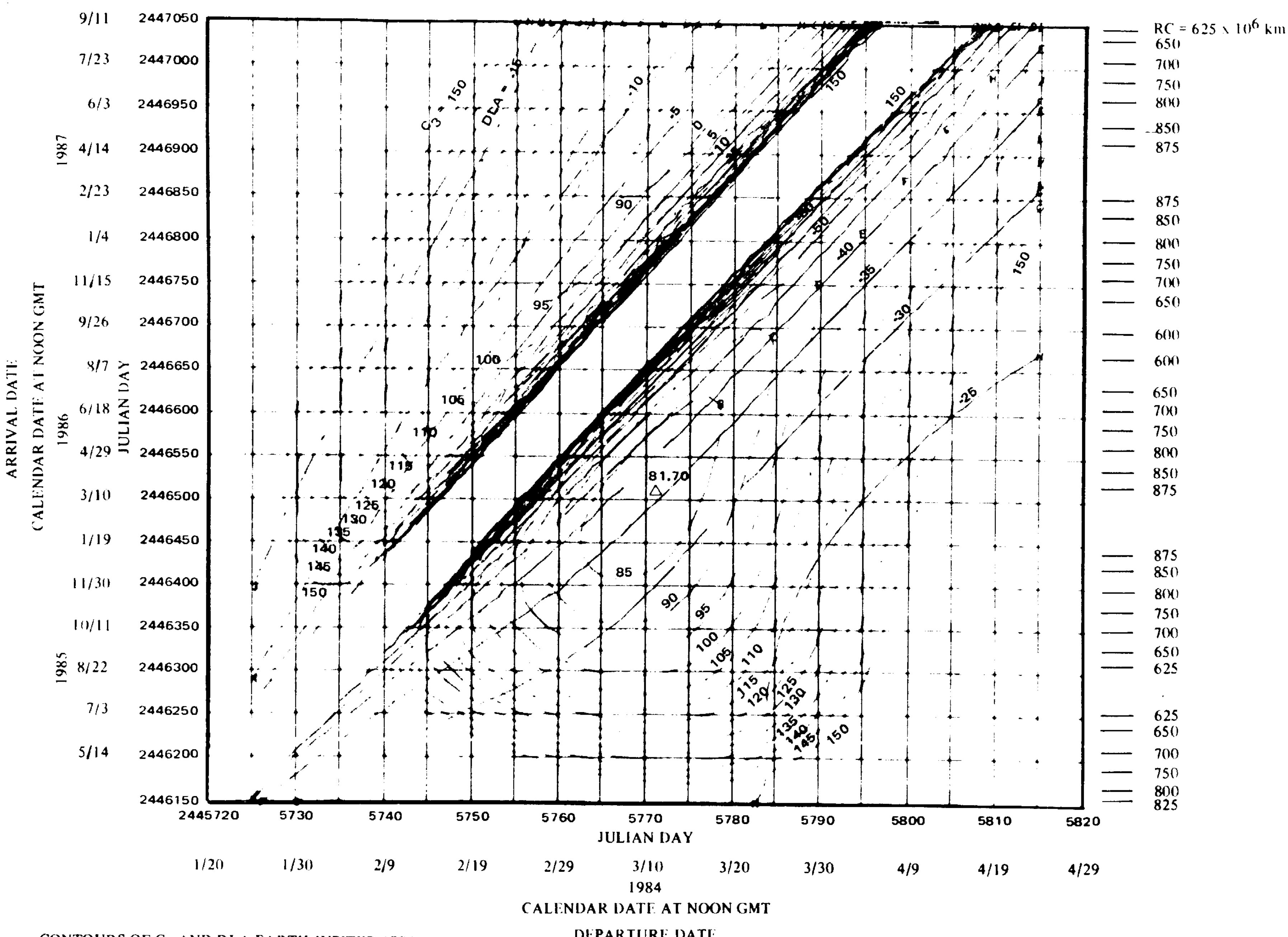
CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1983



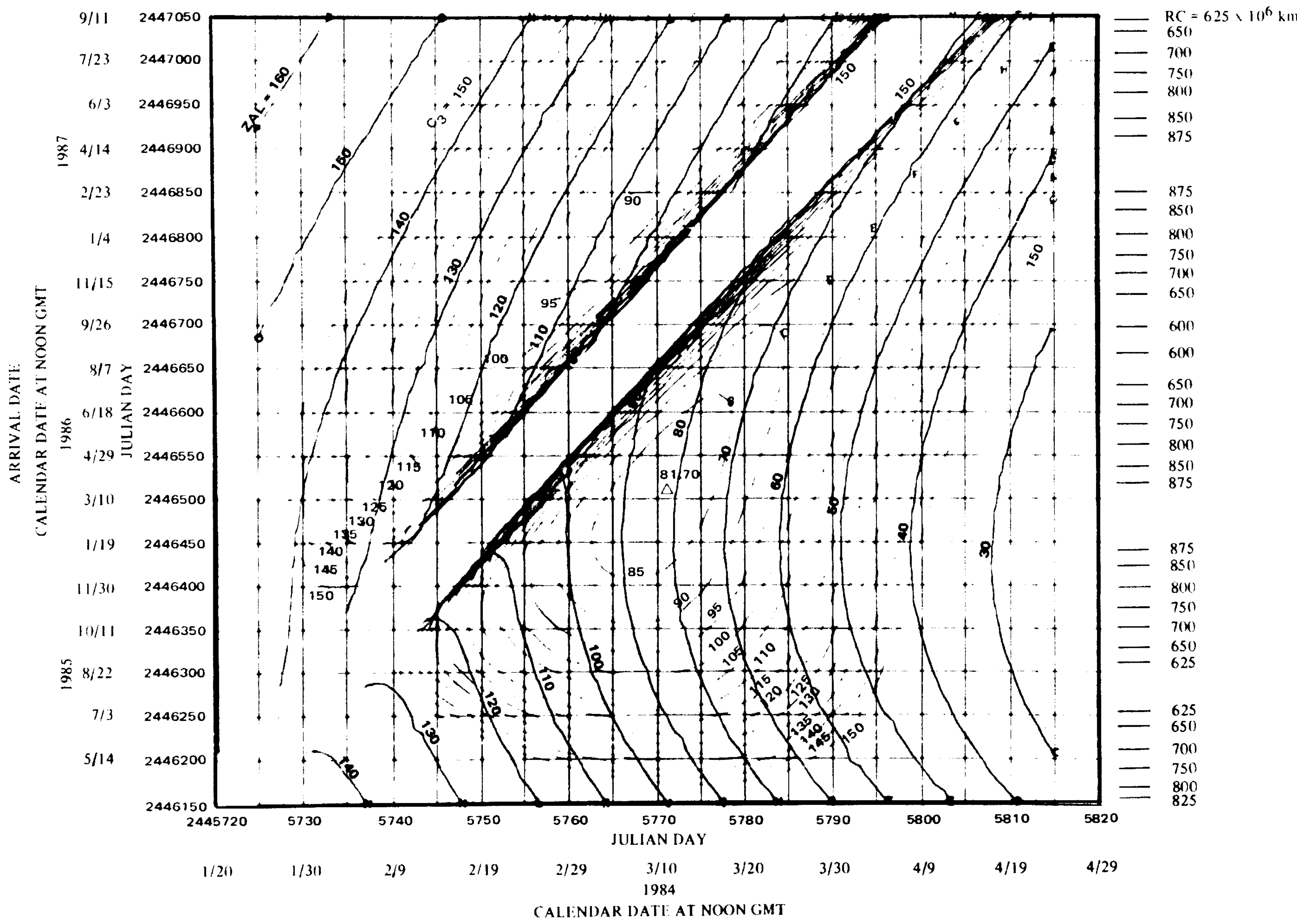
CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1984



CONTOURS OF C_3 AND VHP EARTH JUPITER 1984



CONTOURS OF C_3 AND DLA EARTH JUPITER 1984



CONTOURS OF C_3 AND ZAL EARTH JUPITER 1984

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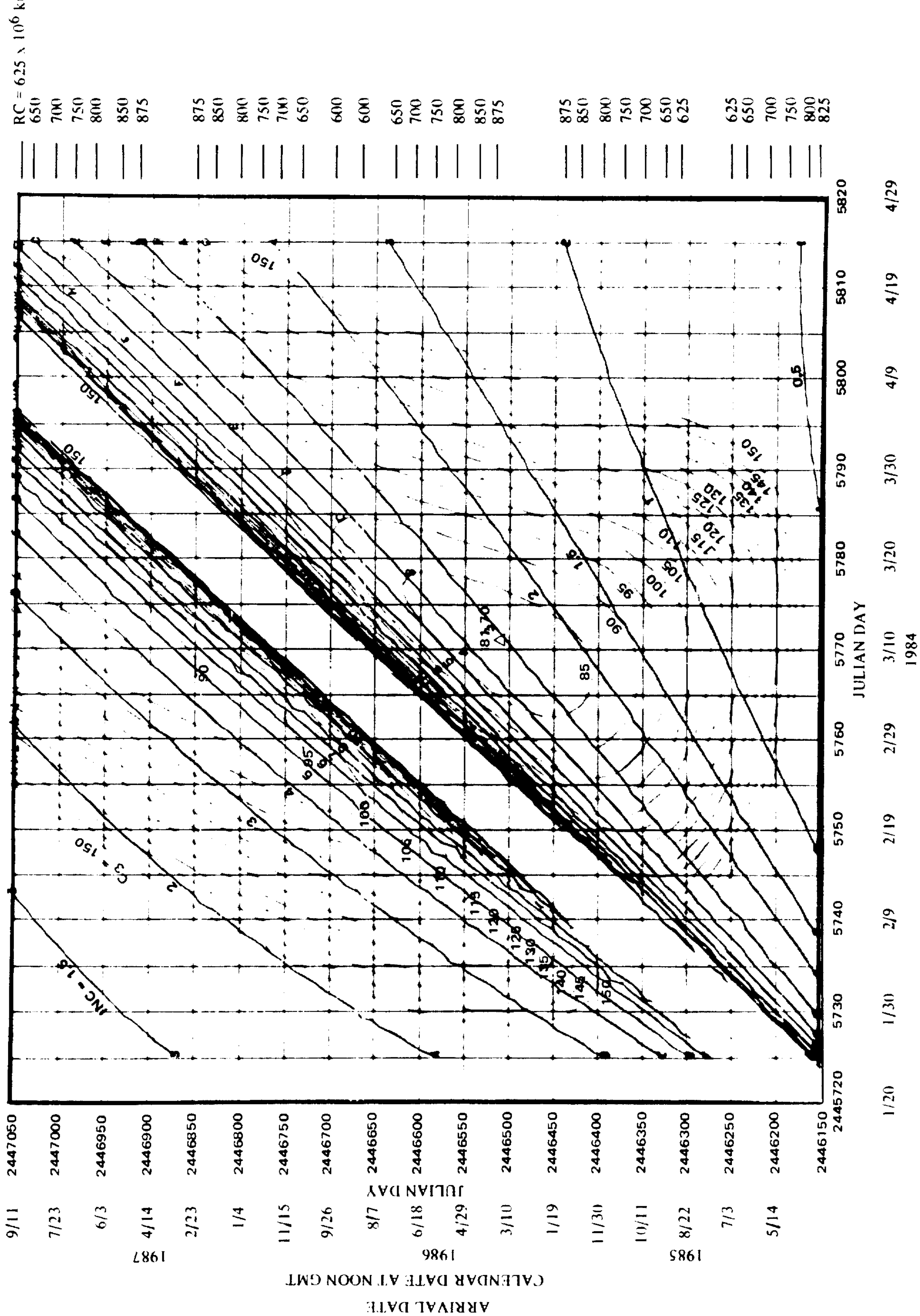

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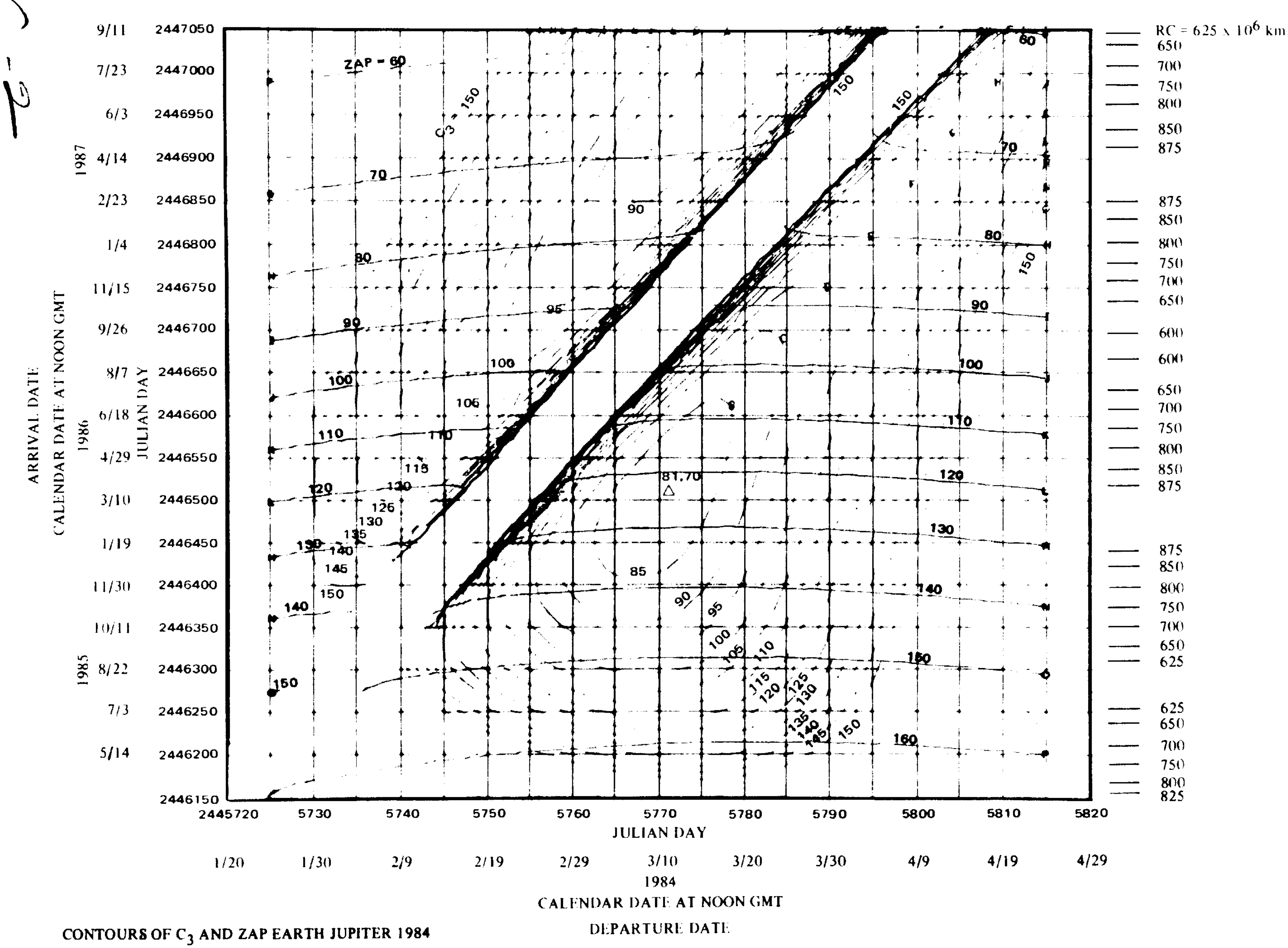

CONTOURS OF C_3 AND ZAP EARTH JUPITER 1984

C-2

ZAI
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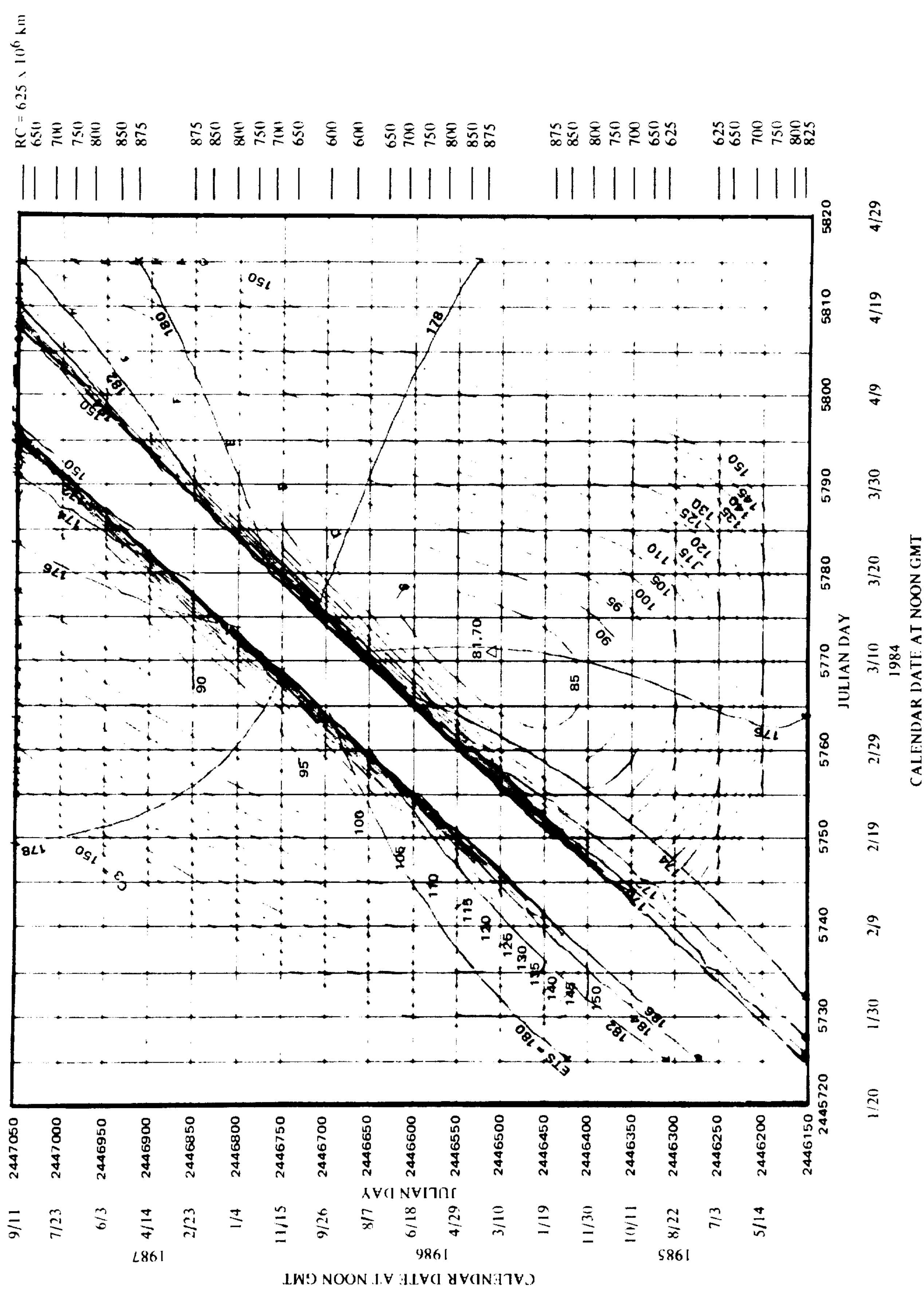

CONTOURS OF C_3 AND ETS EARTH JUPITER 1984

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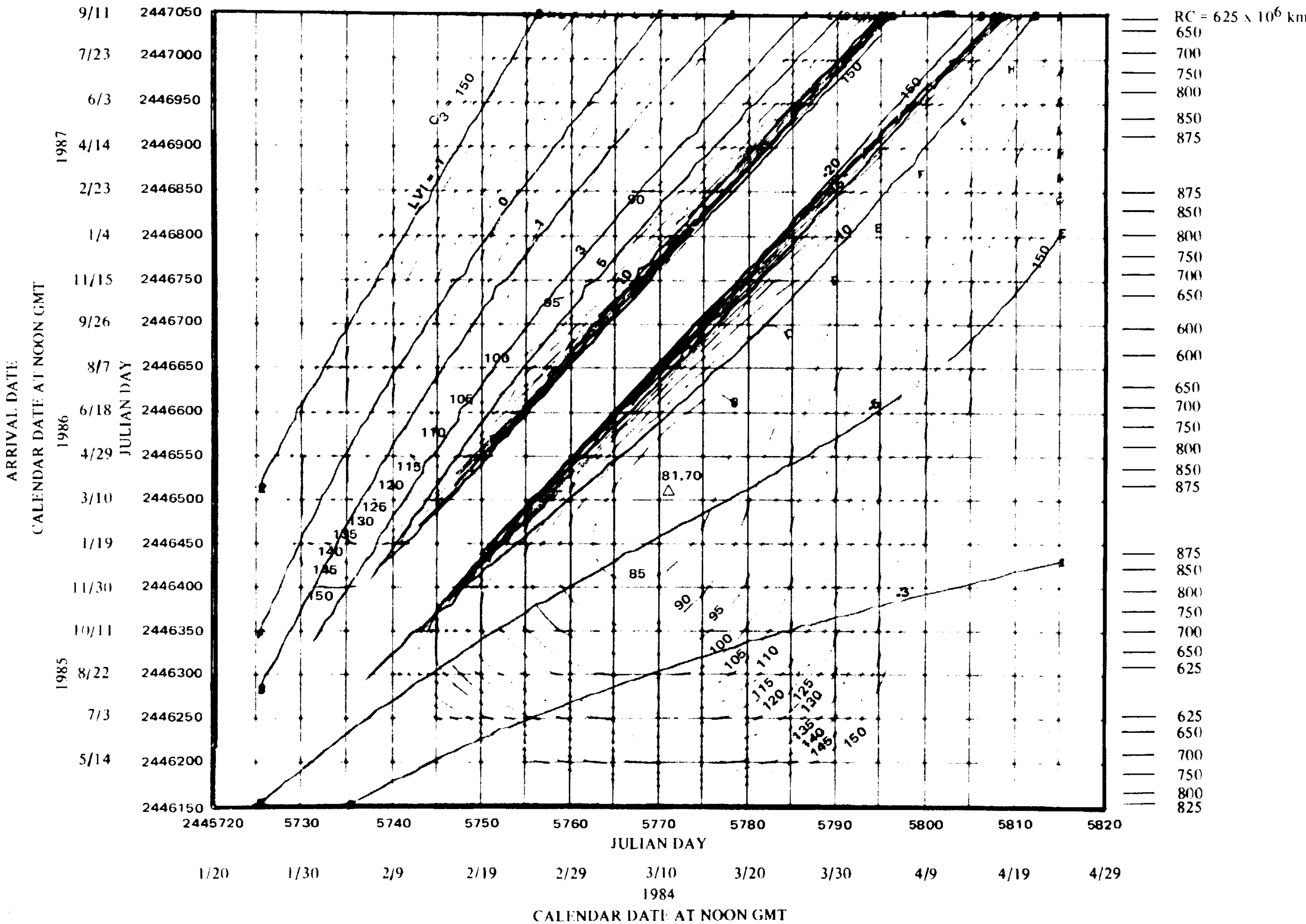
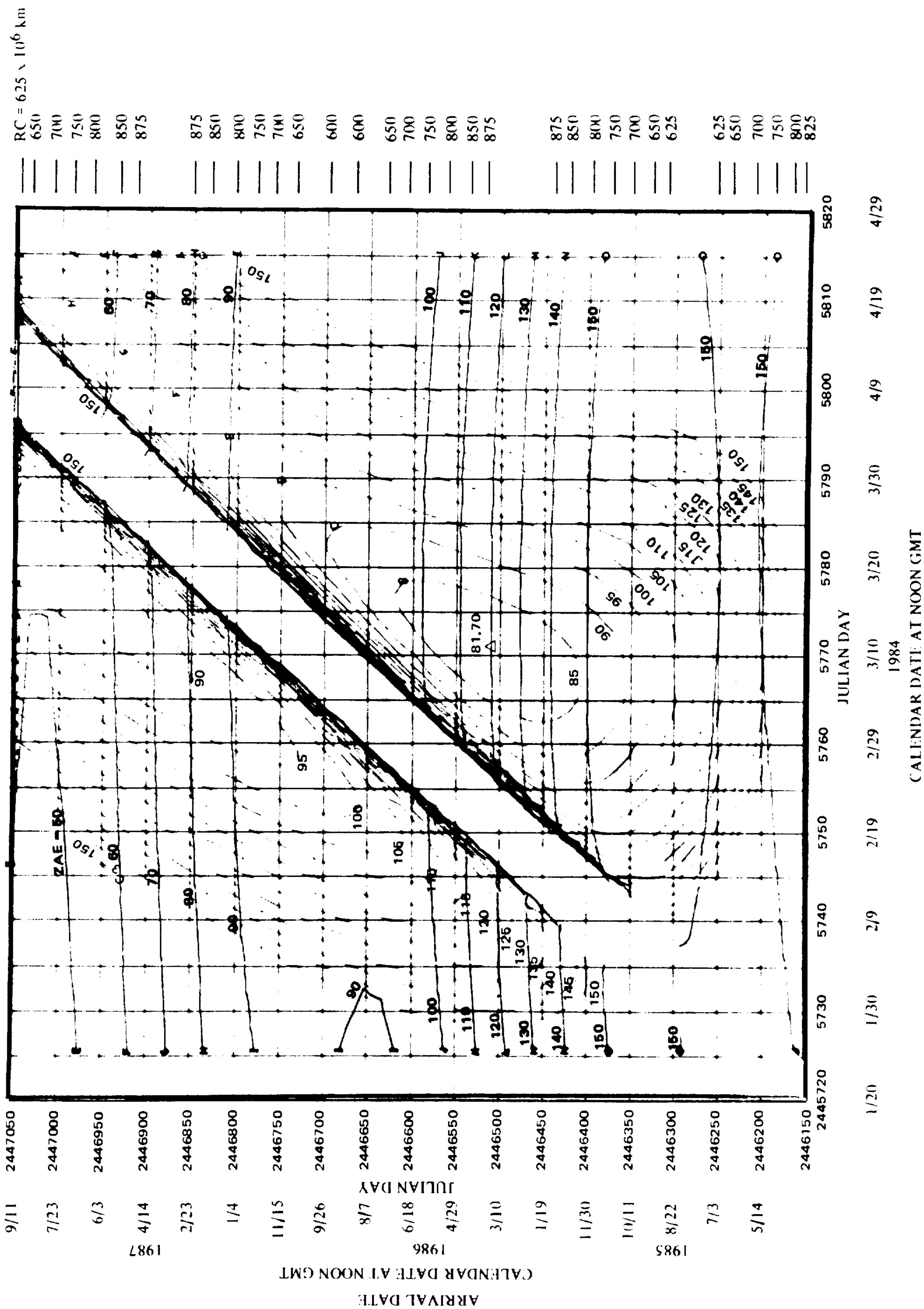
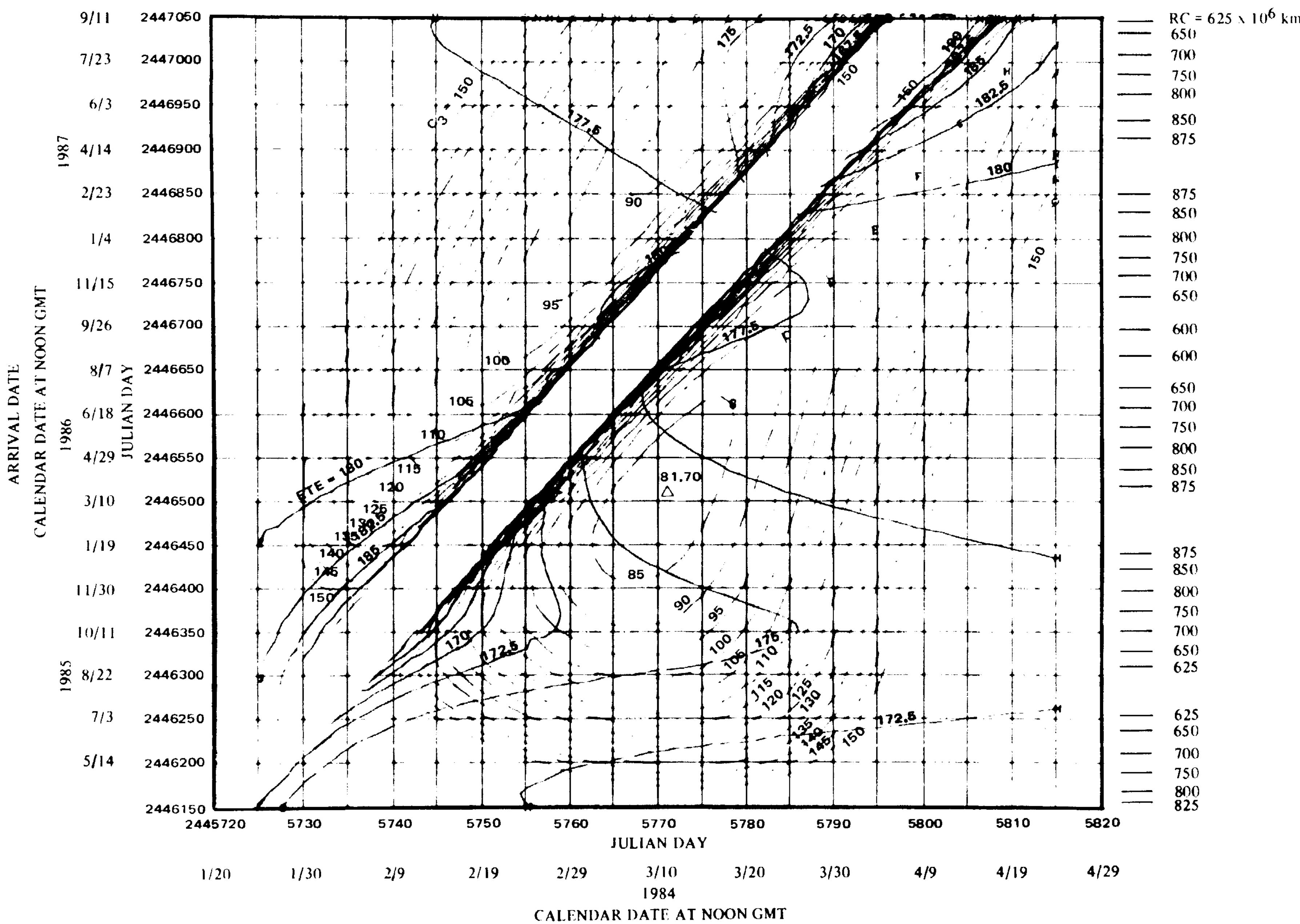


CONTOURS OF C_3 AND LVI EARTH JUPITER 1984



CONTOURS OF C_3 AND ZAE EARTH JUPITER 1984



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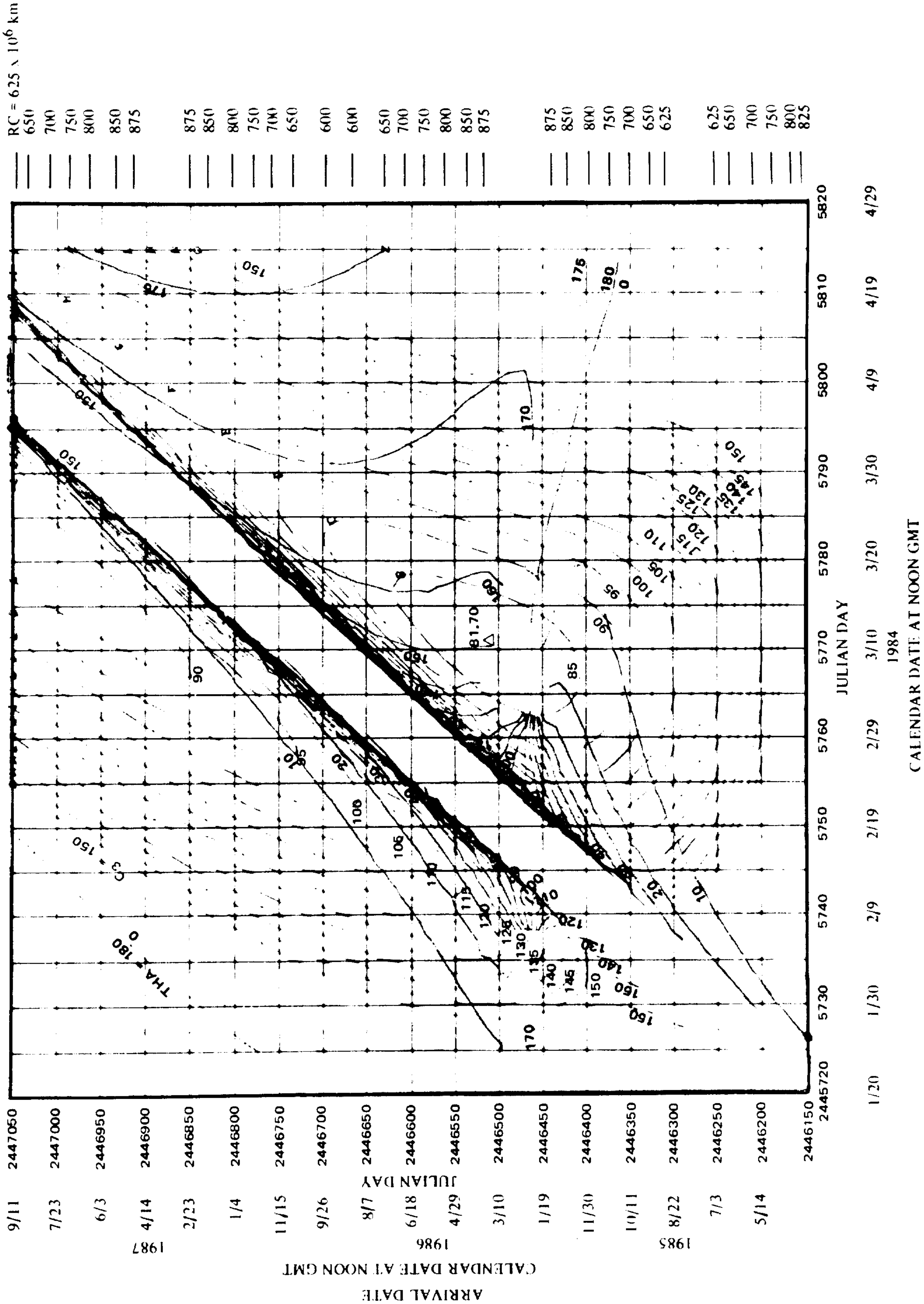
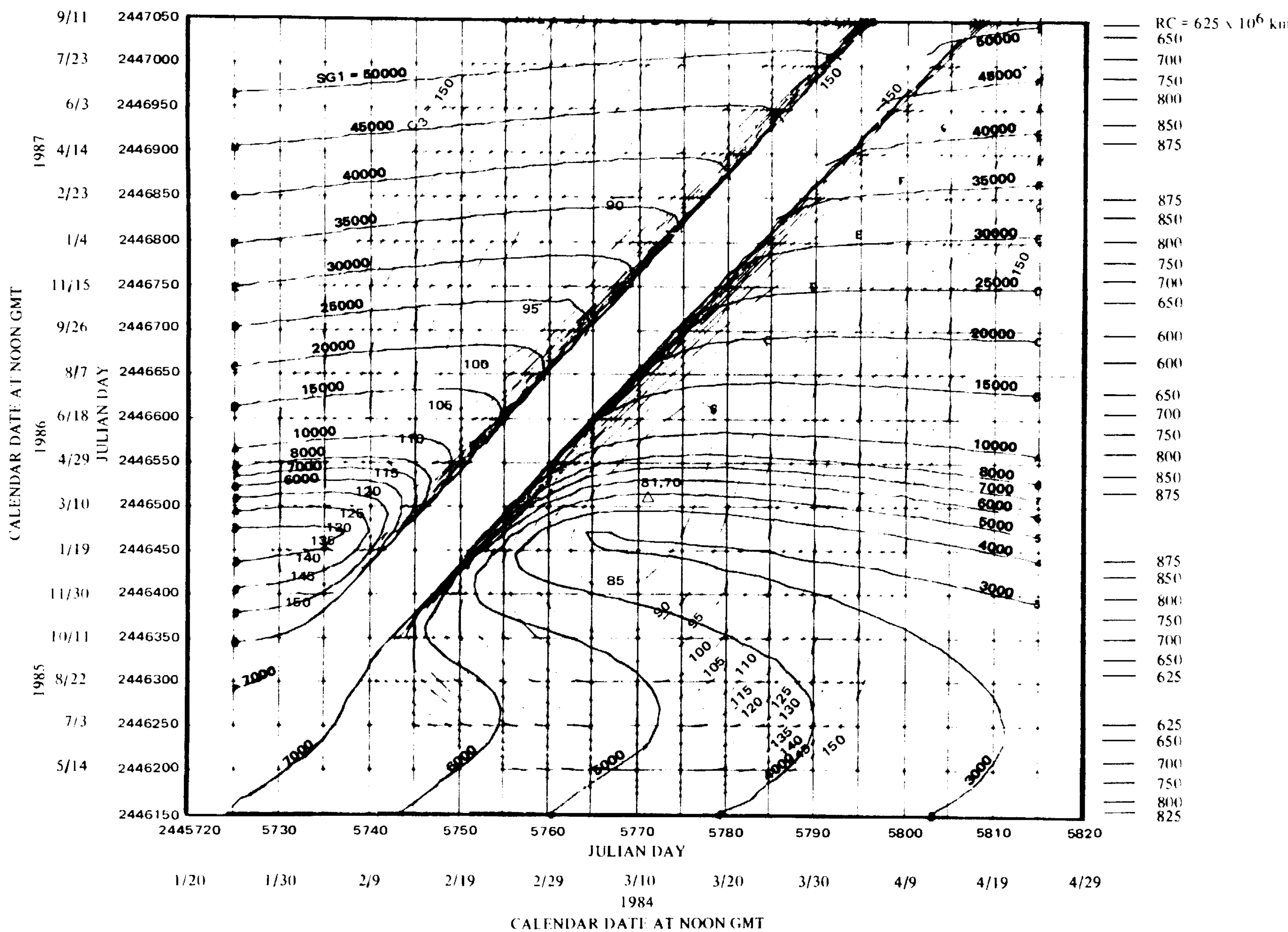
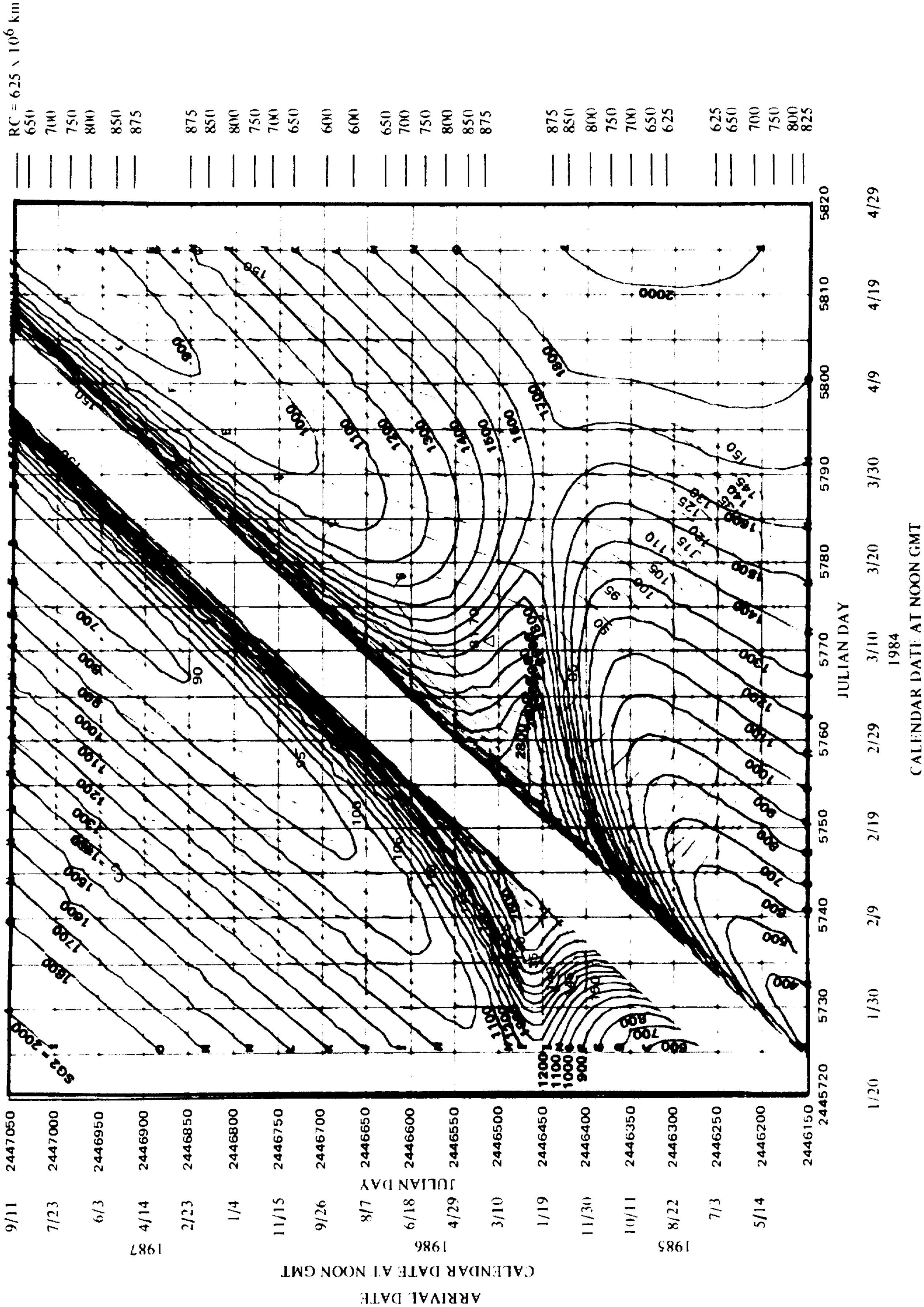
CONTOURS OF C_3 AND ETE EARTH JUPITER 1984



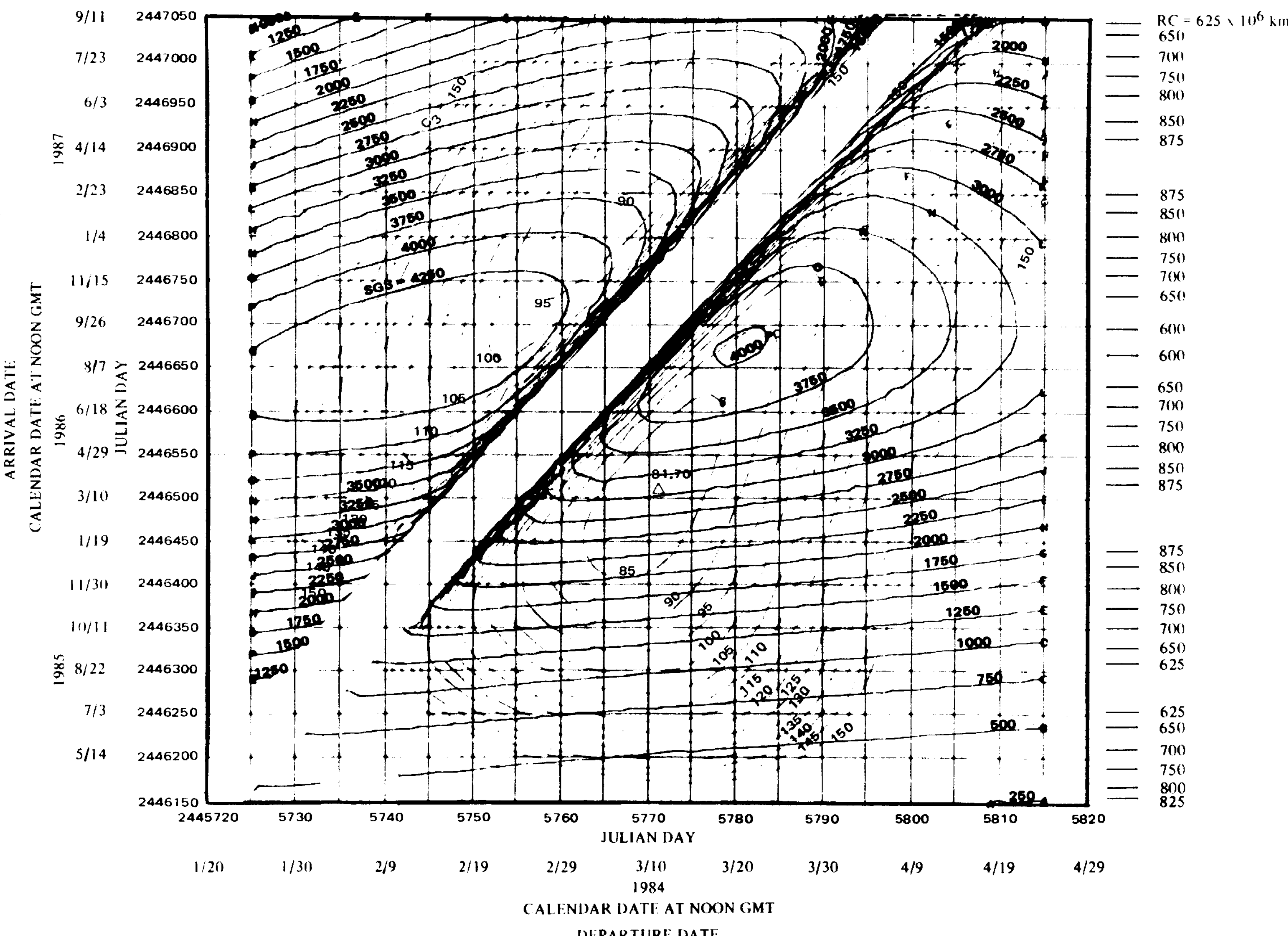
CONTOURS OF C_3 AND THA EARTH JUPITER 1984



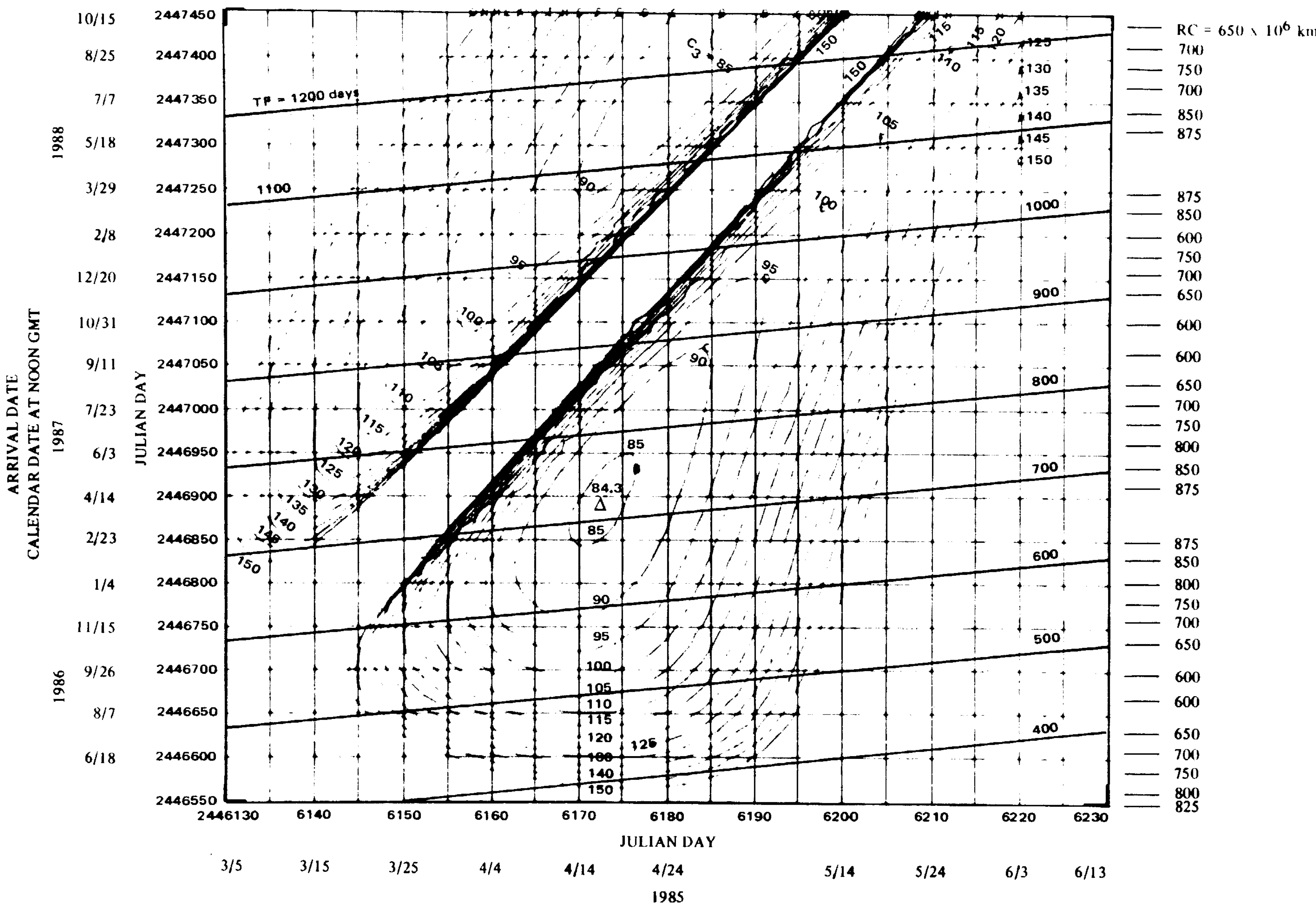
CONTOURS OF C_3 AND SG1 EARTH JUPITER 1984



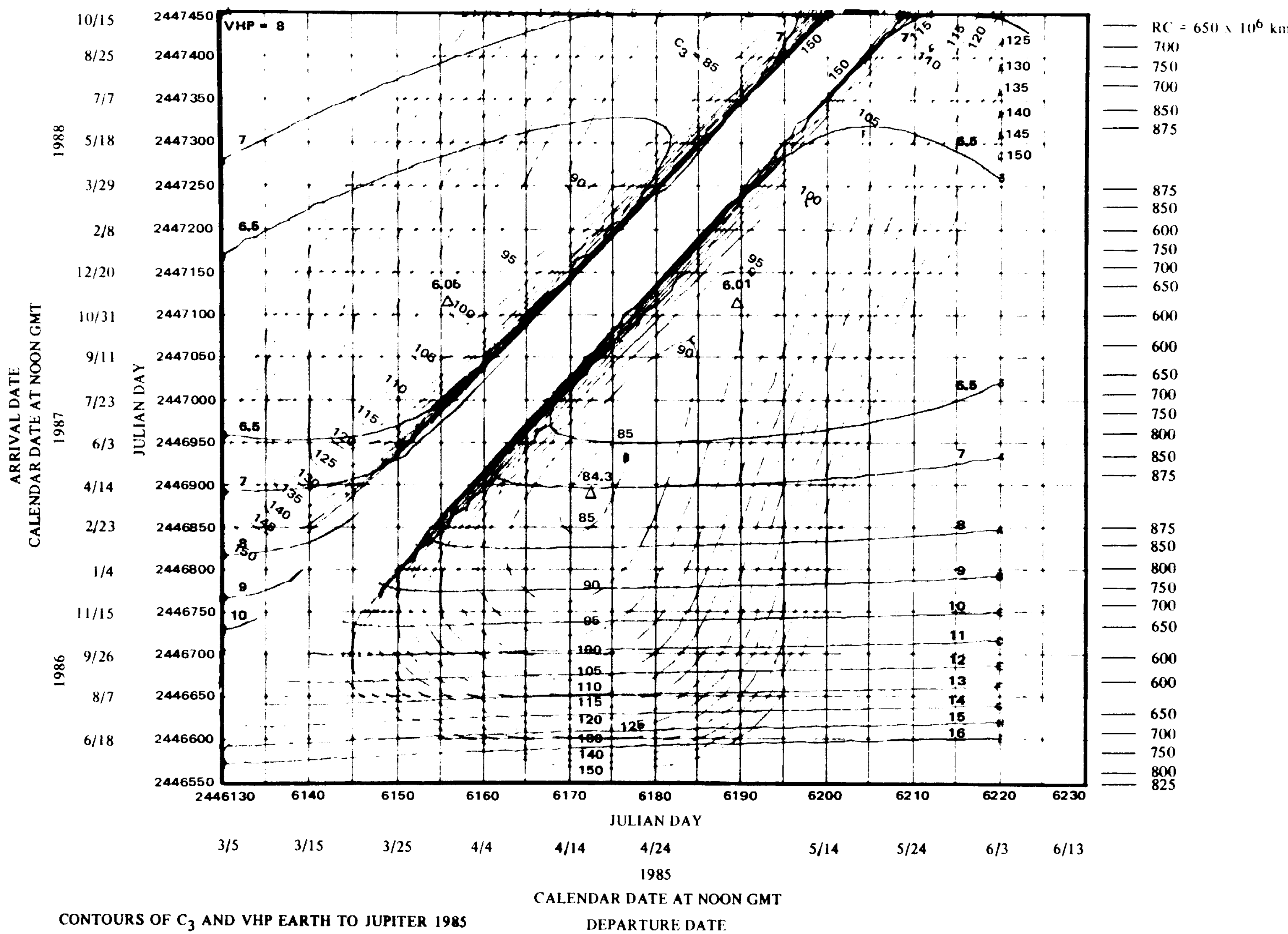
CONTOURS OF C_3 AND SG2 EARTH JUPITER 1984



CONTOURS OF C_3 AND SG3 EARTH JUPITER 1984



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1985



CONTOURS OF C_3 AND VHP EARTH TO JUPITER 1985

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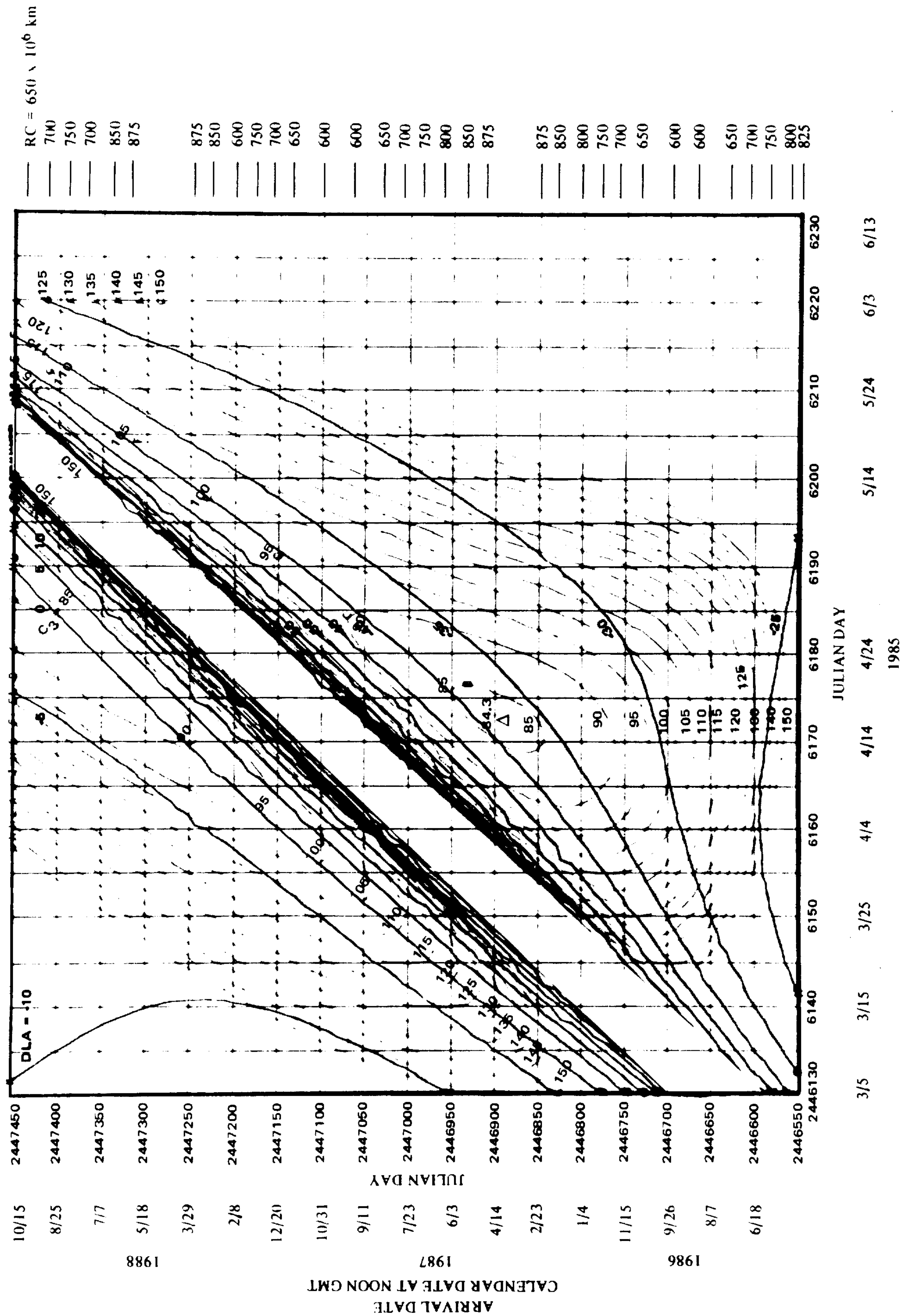
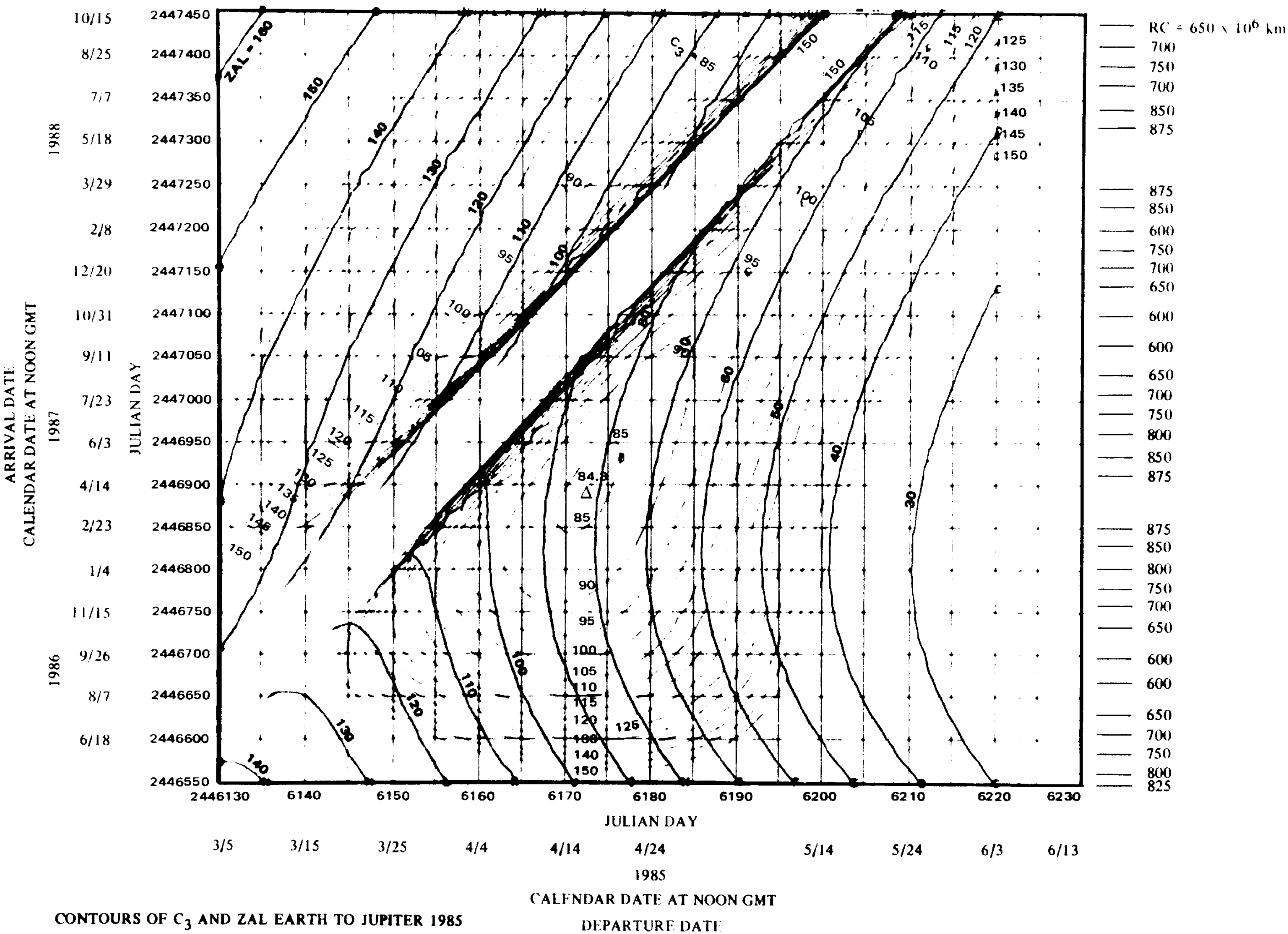
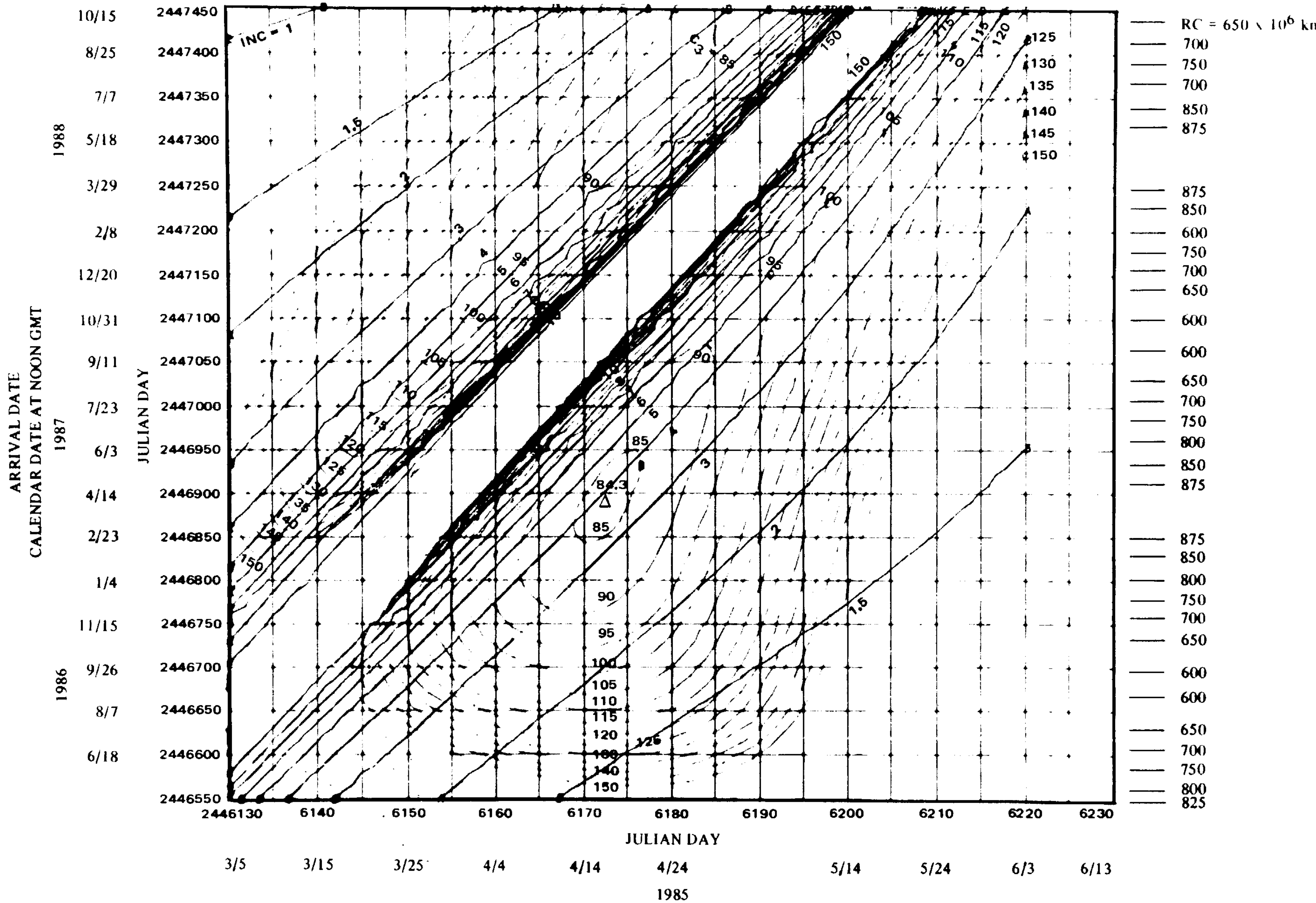


CONTOURS OF C_3 AND DLA EARTH TO JUPITER 1985

ZAI 4 198



CONTOURS OF C_3 AND ZAL EARTH TO JUPITER 1985



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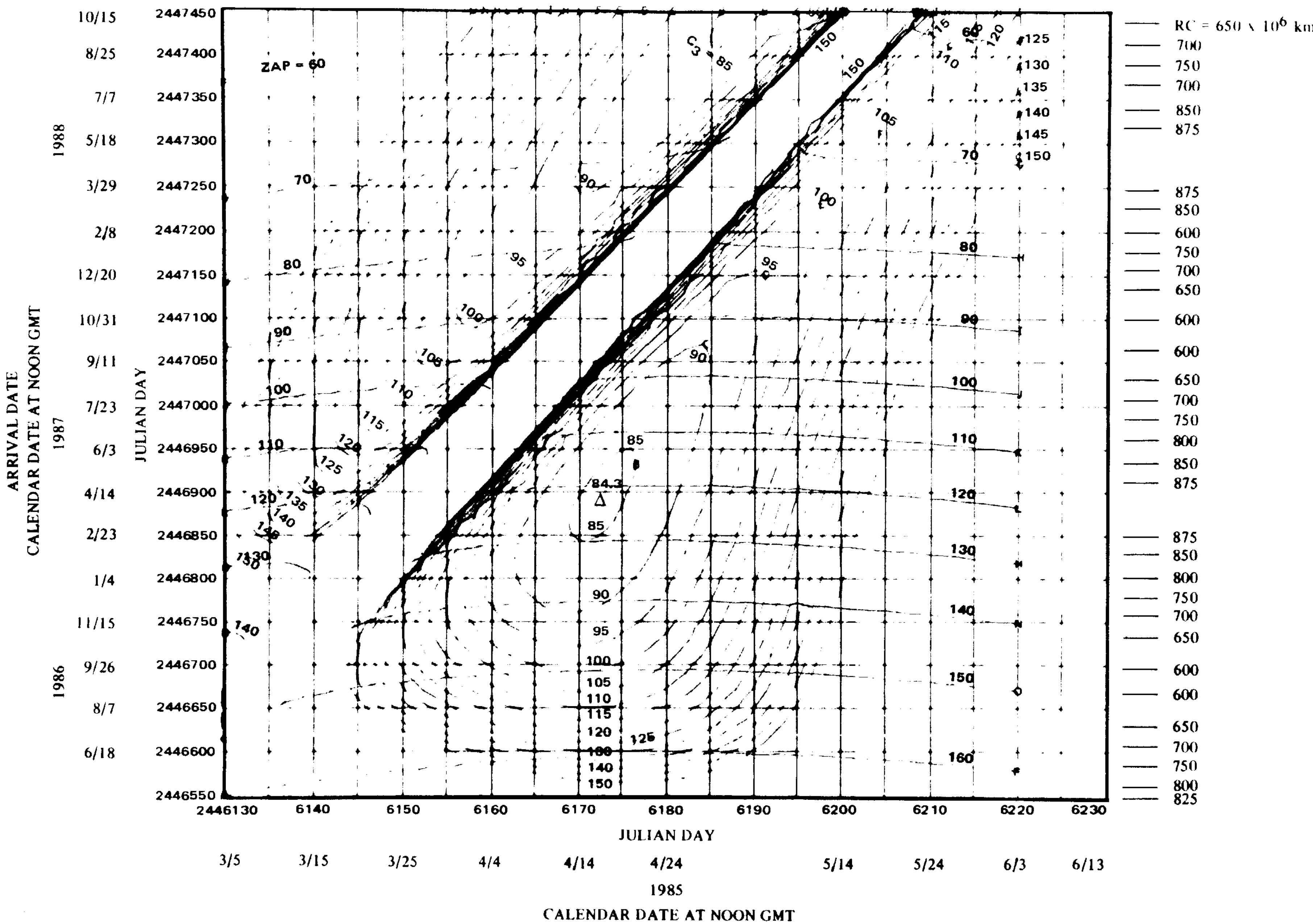
DEPARTURE DATE

CONTOURS OF C_3 AND INC EARTH TO JUPITER 1985



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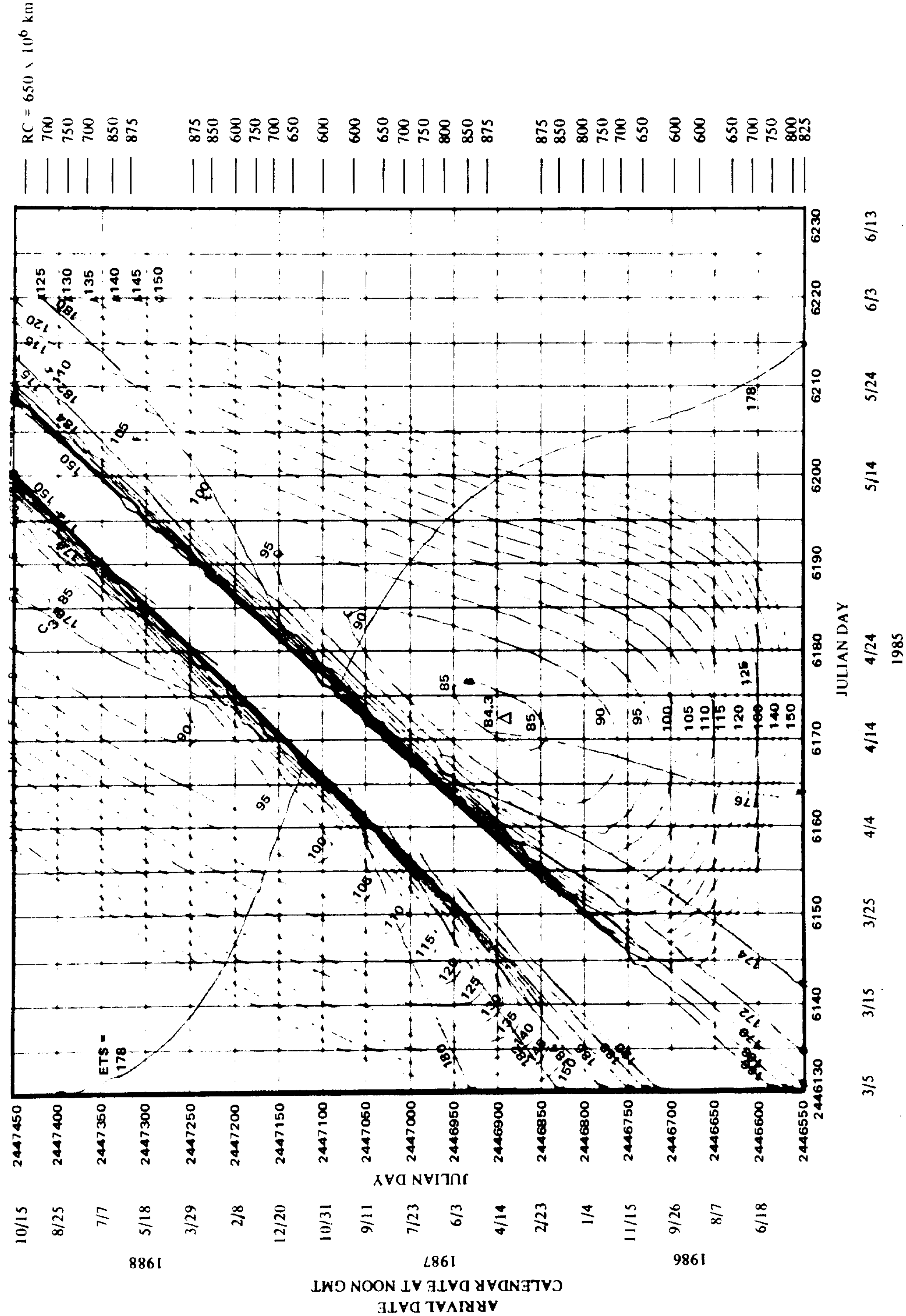

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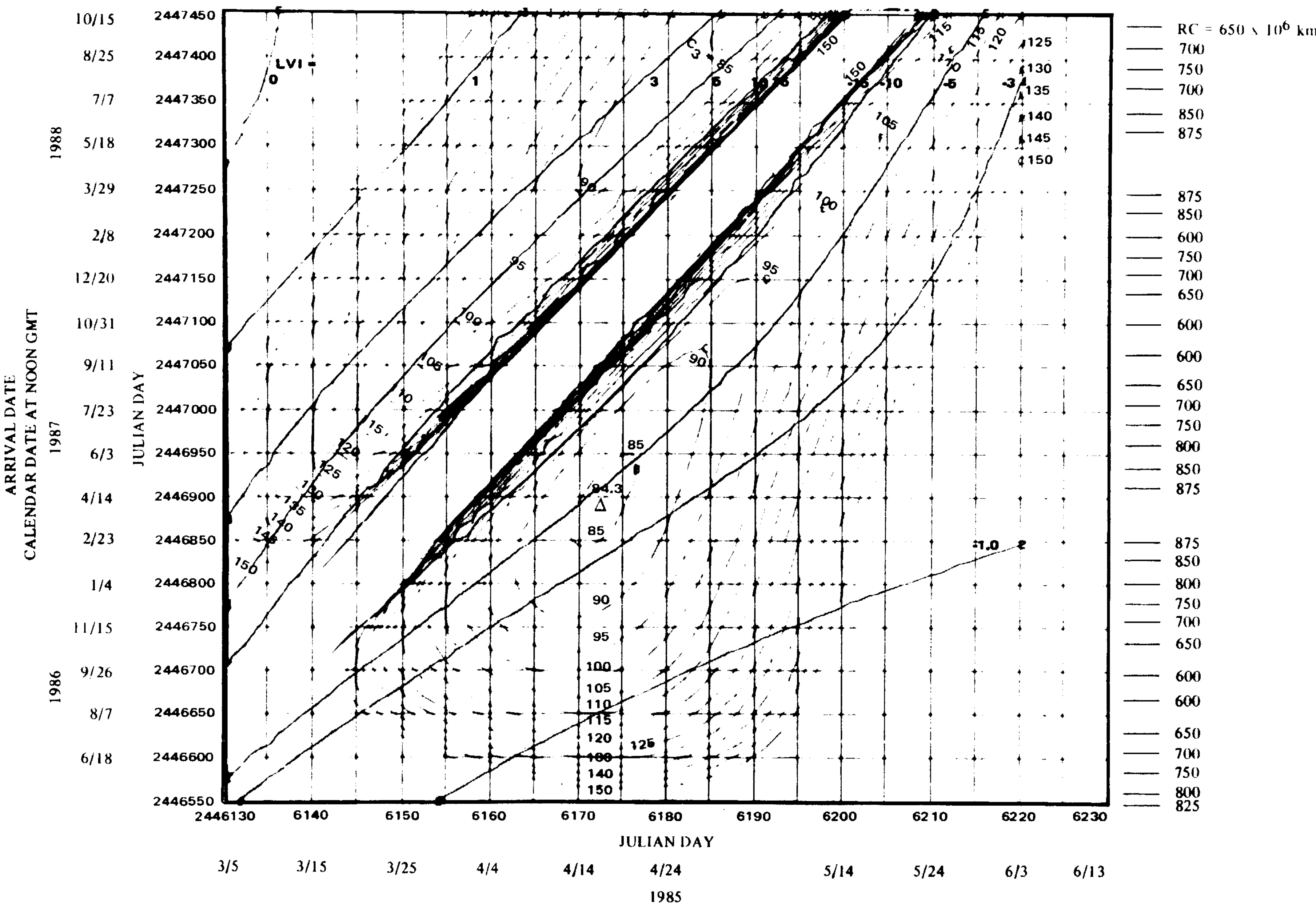

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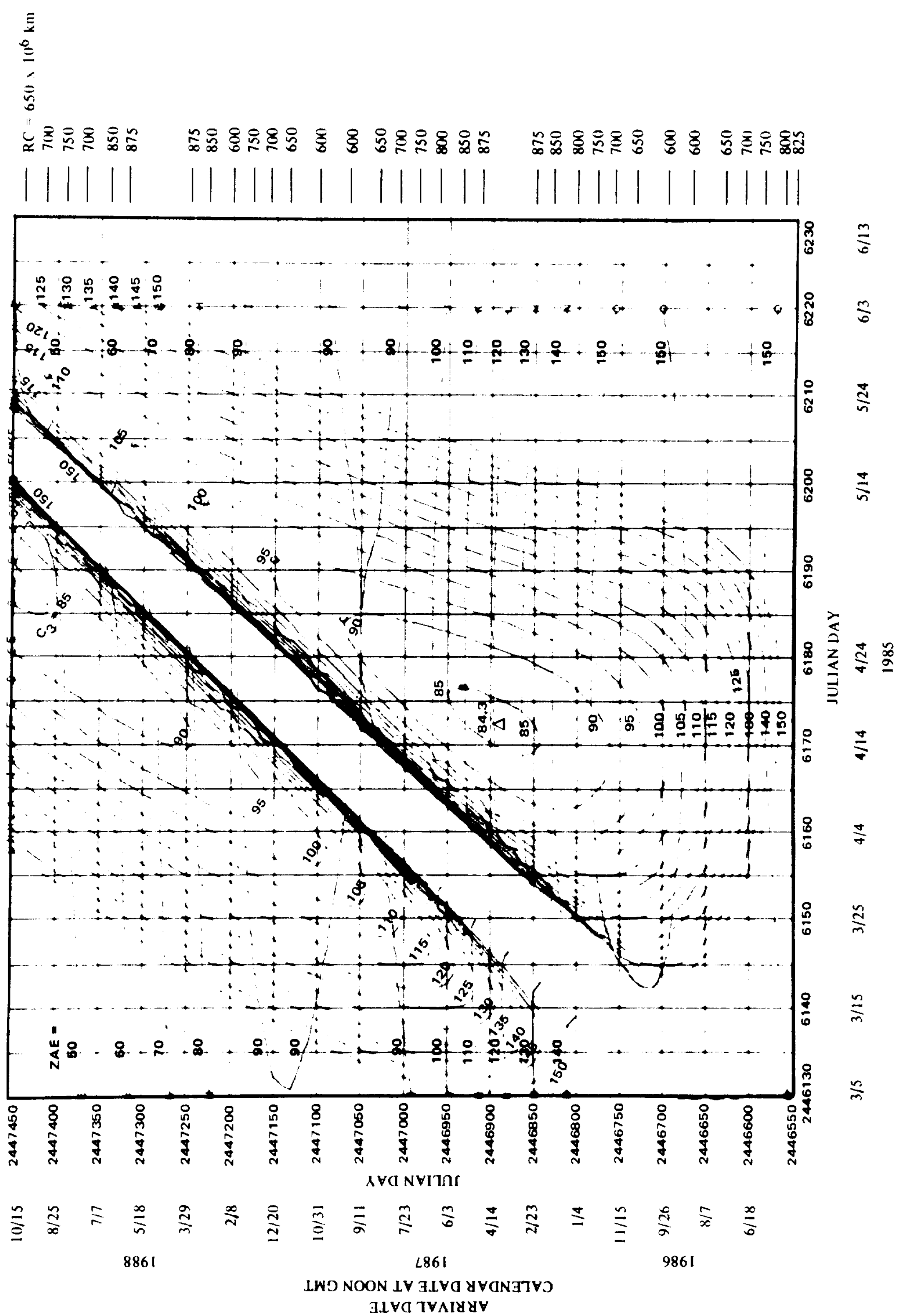

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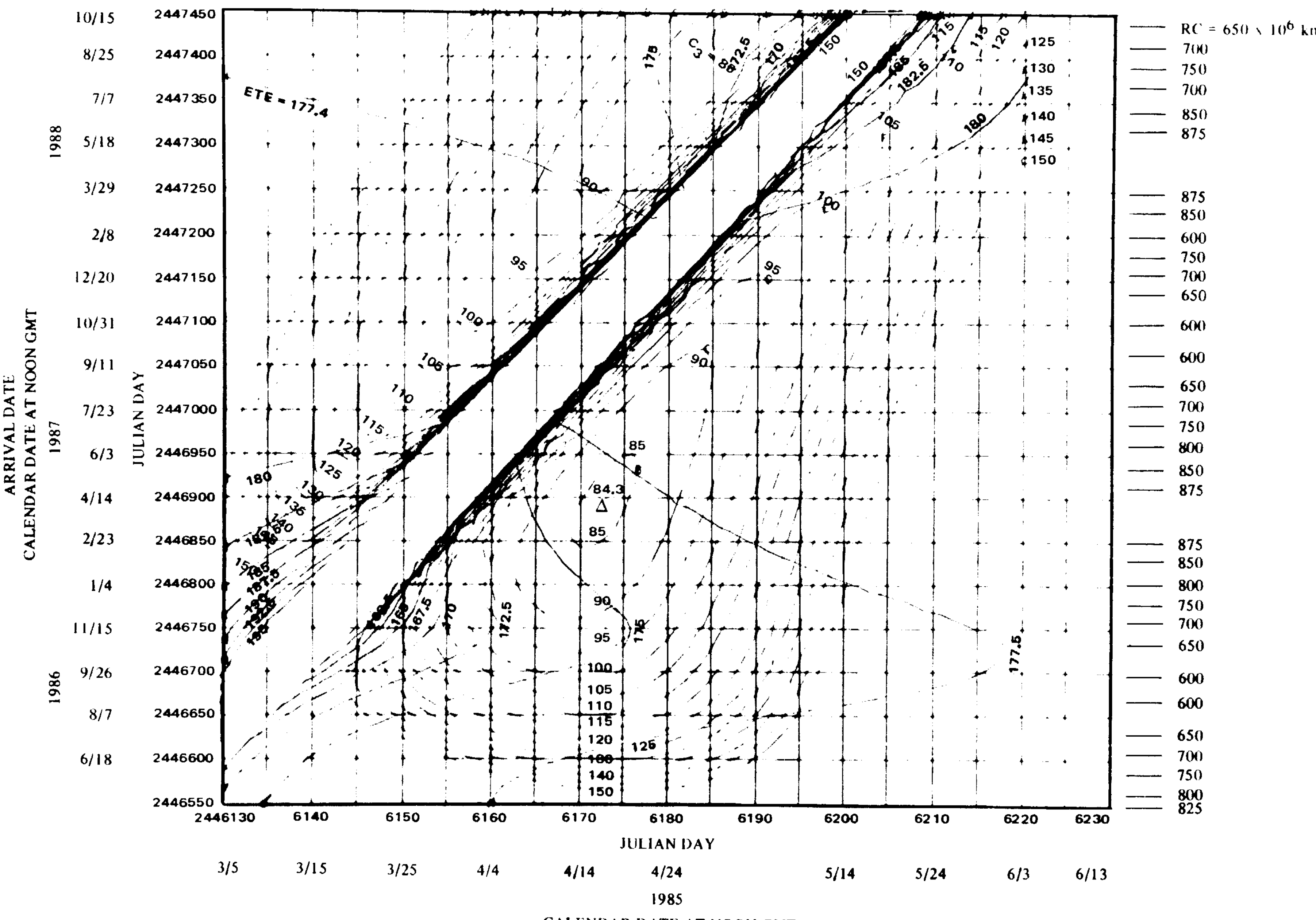

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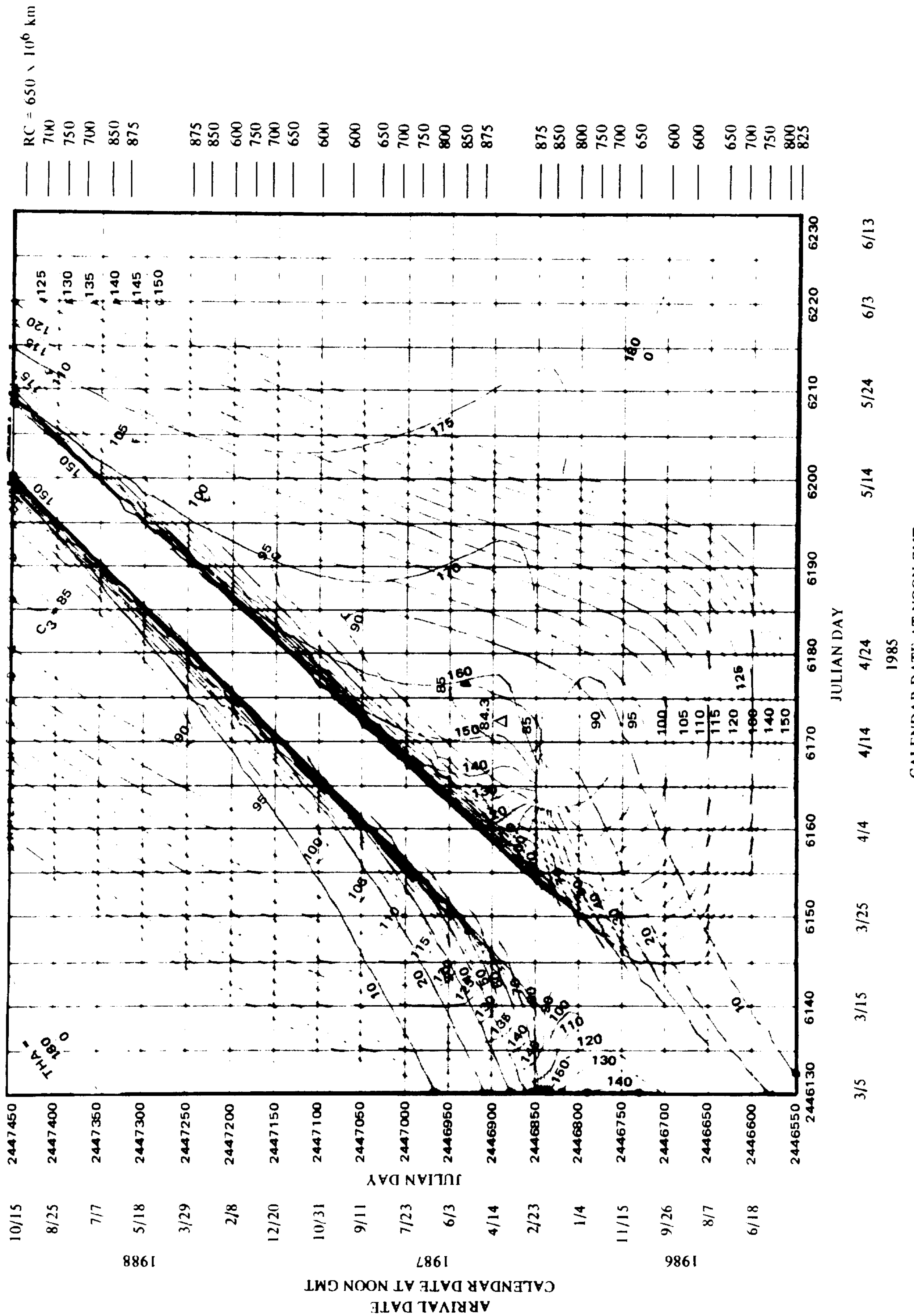

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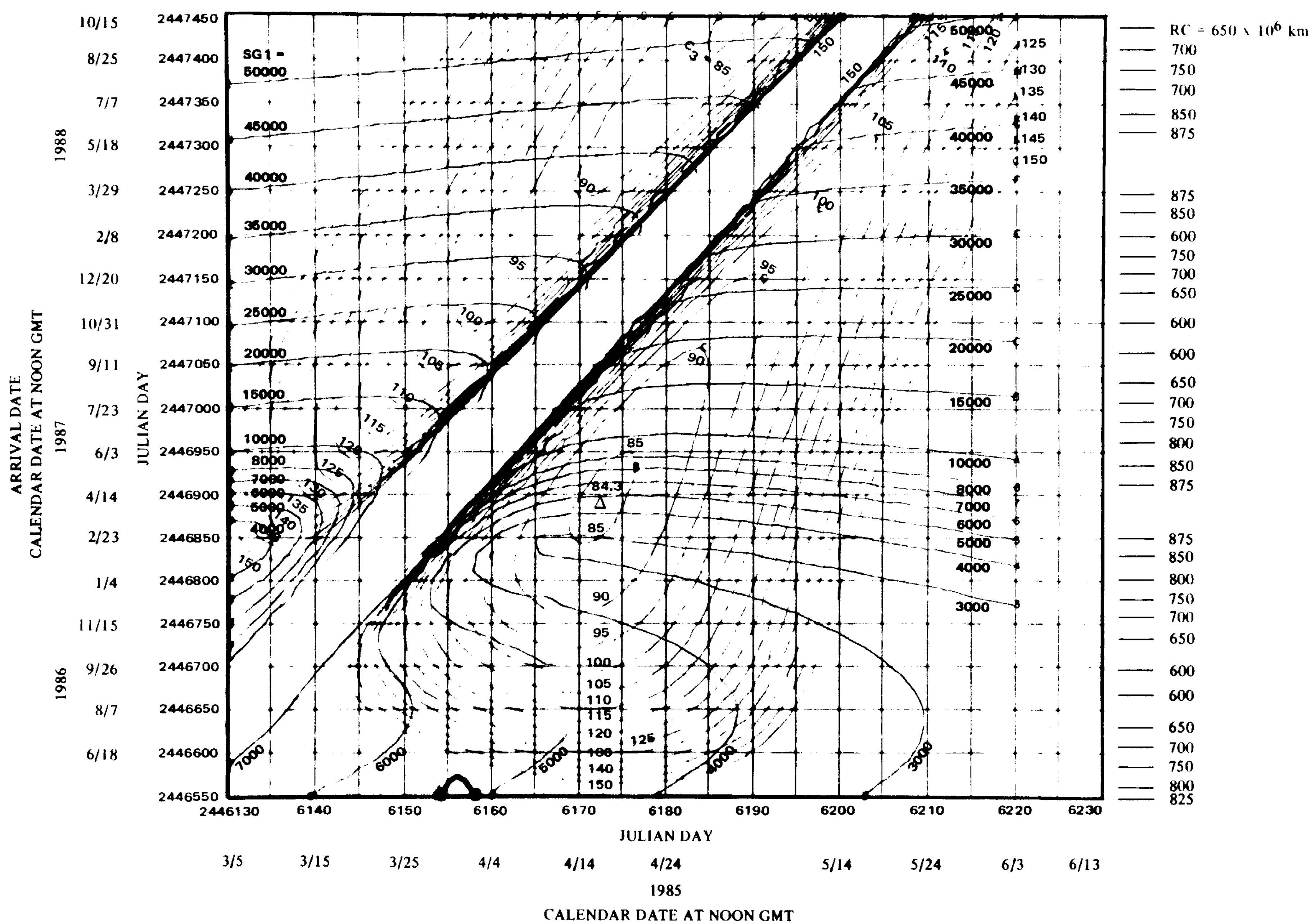

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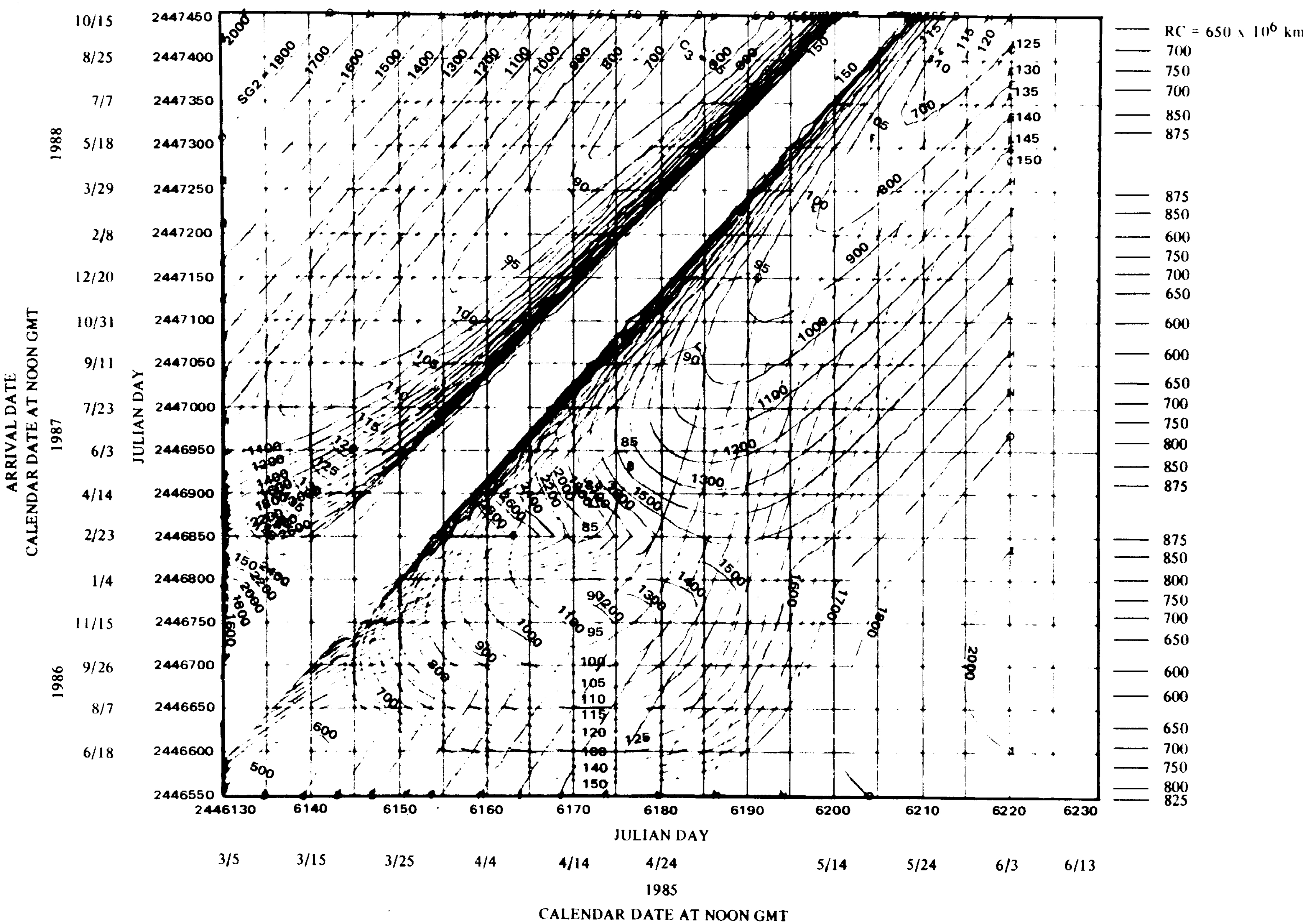

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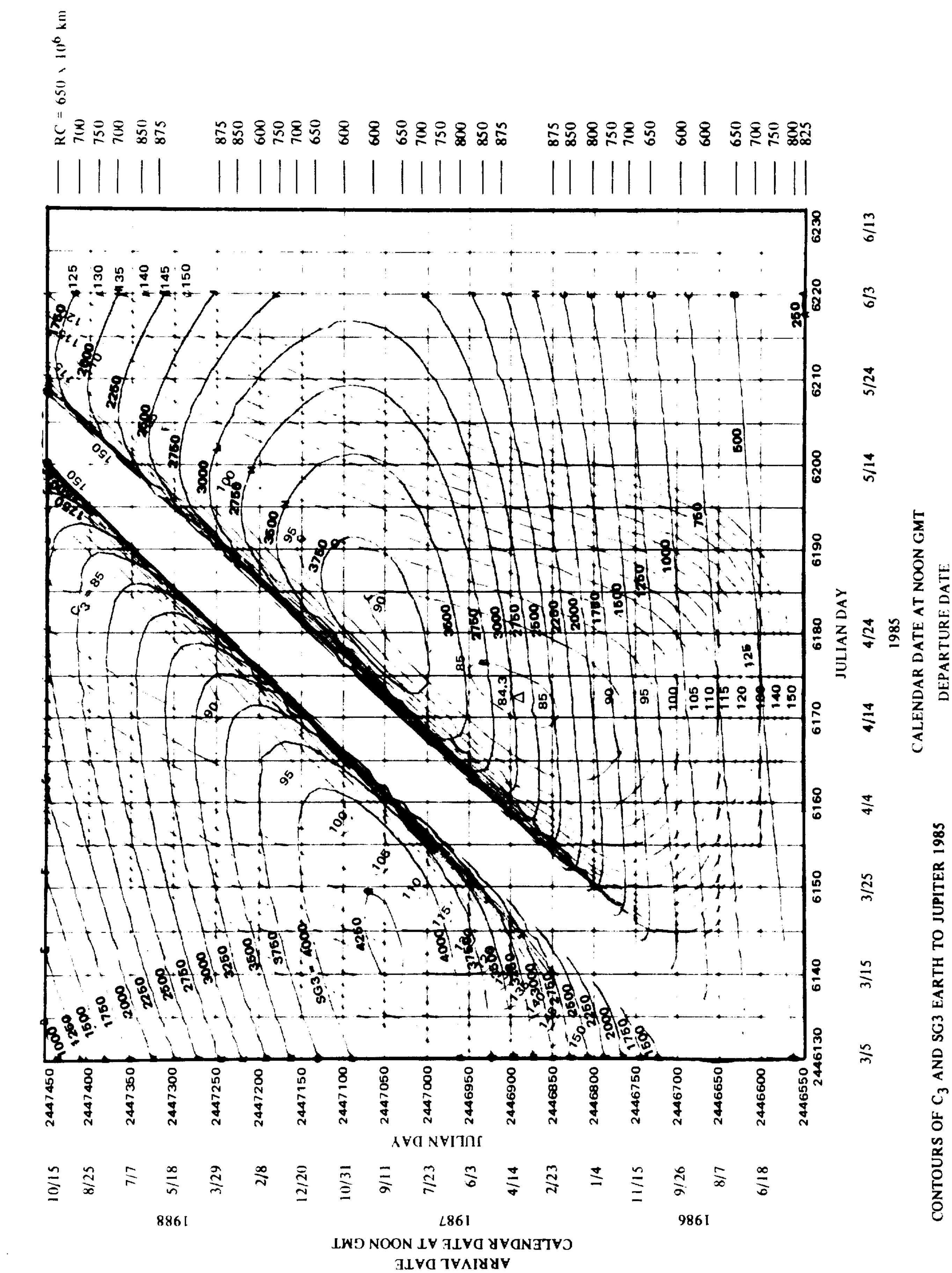

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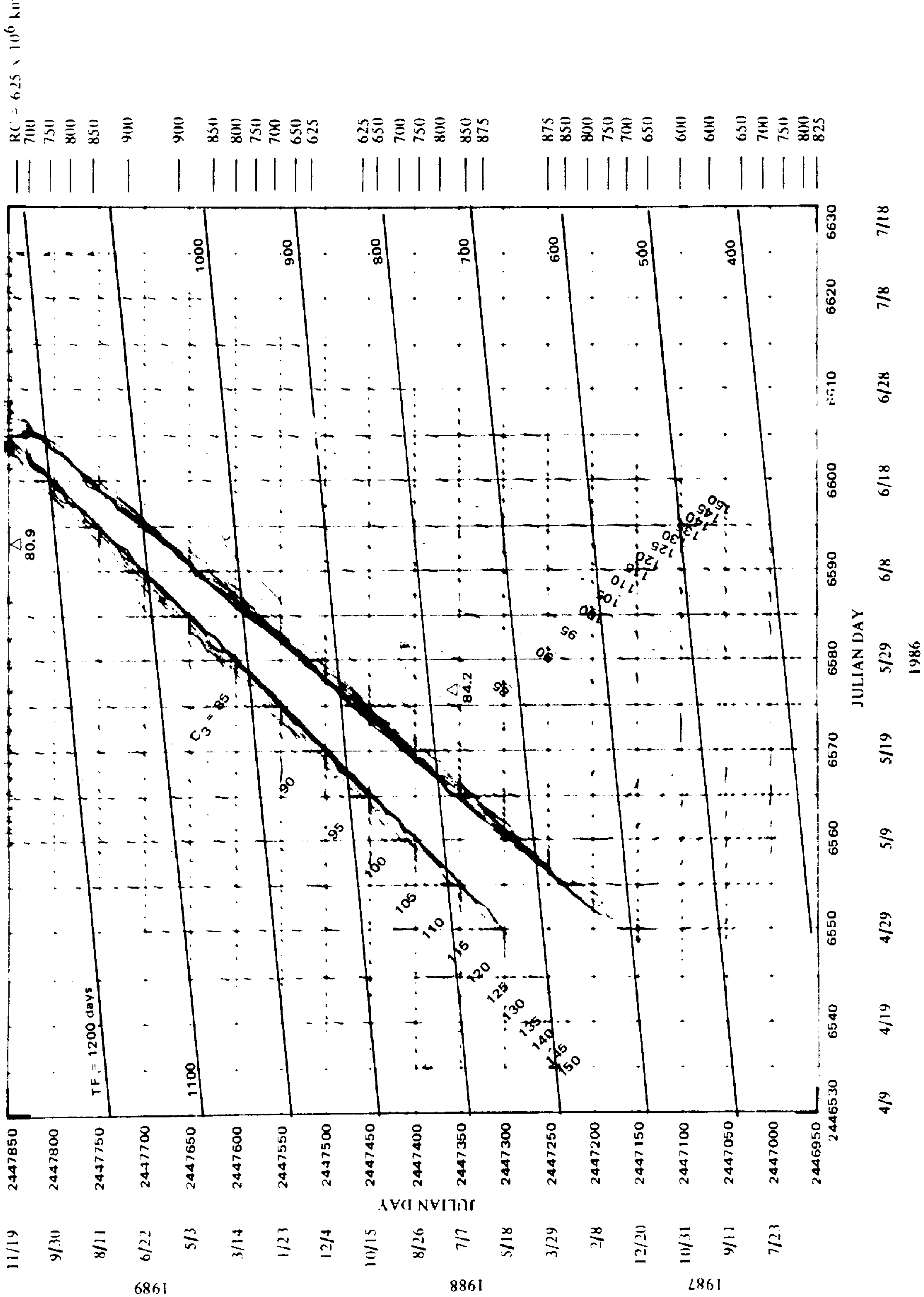
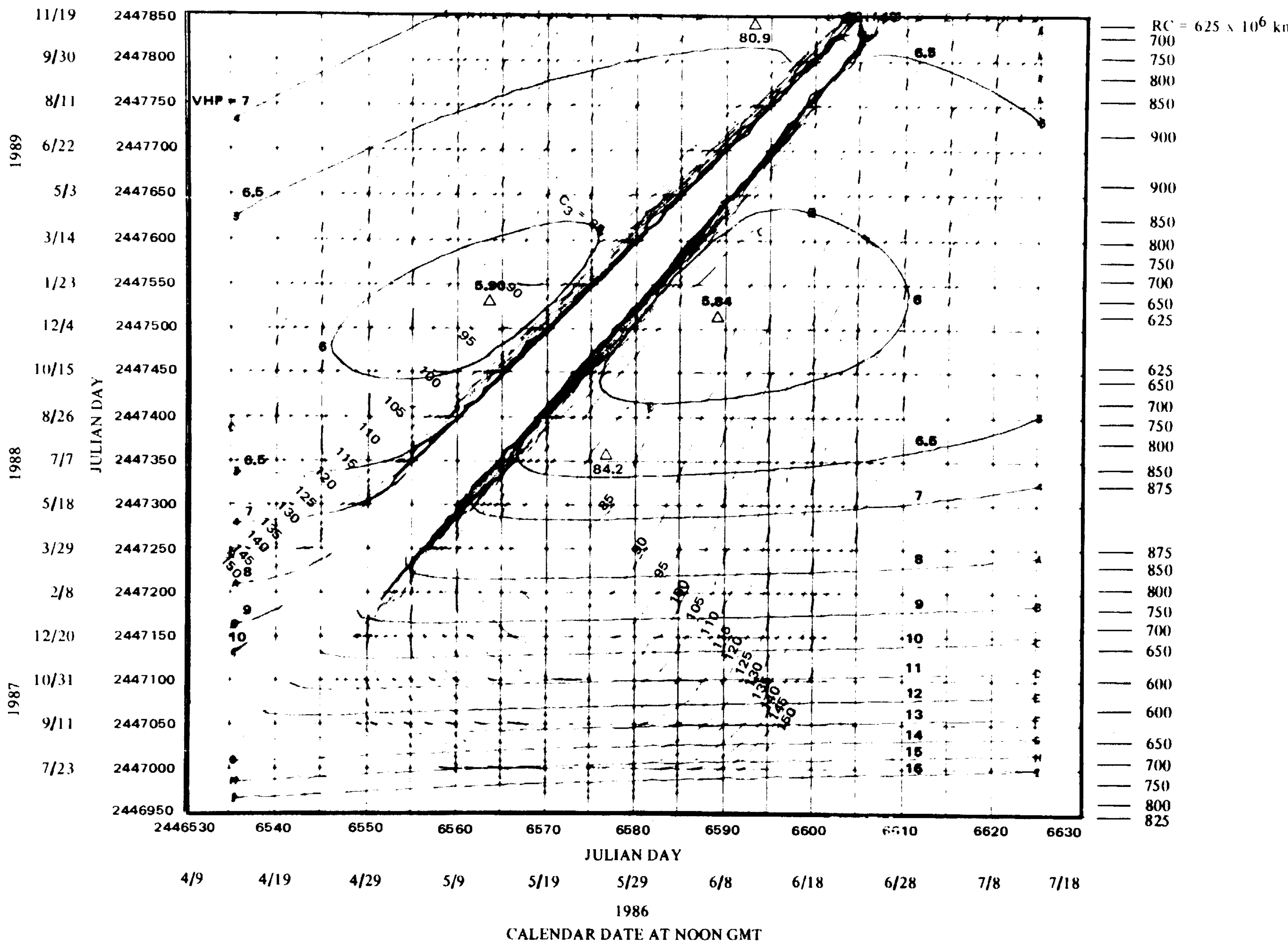


CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1986



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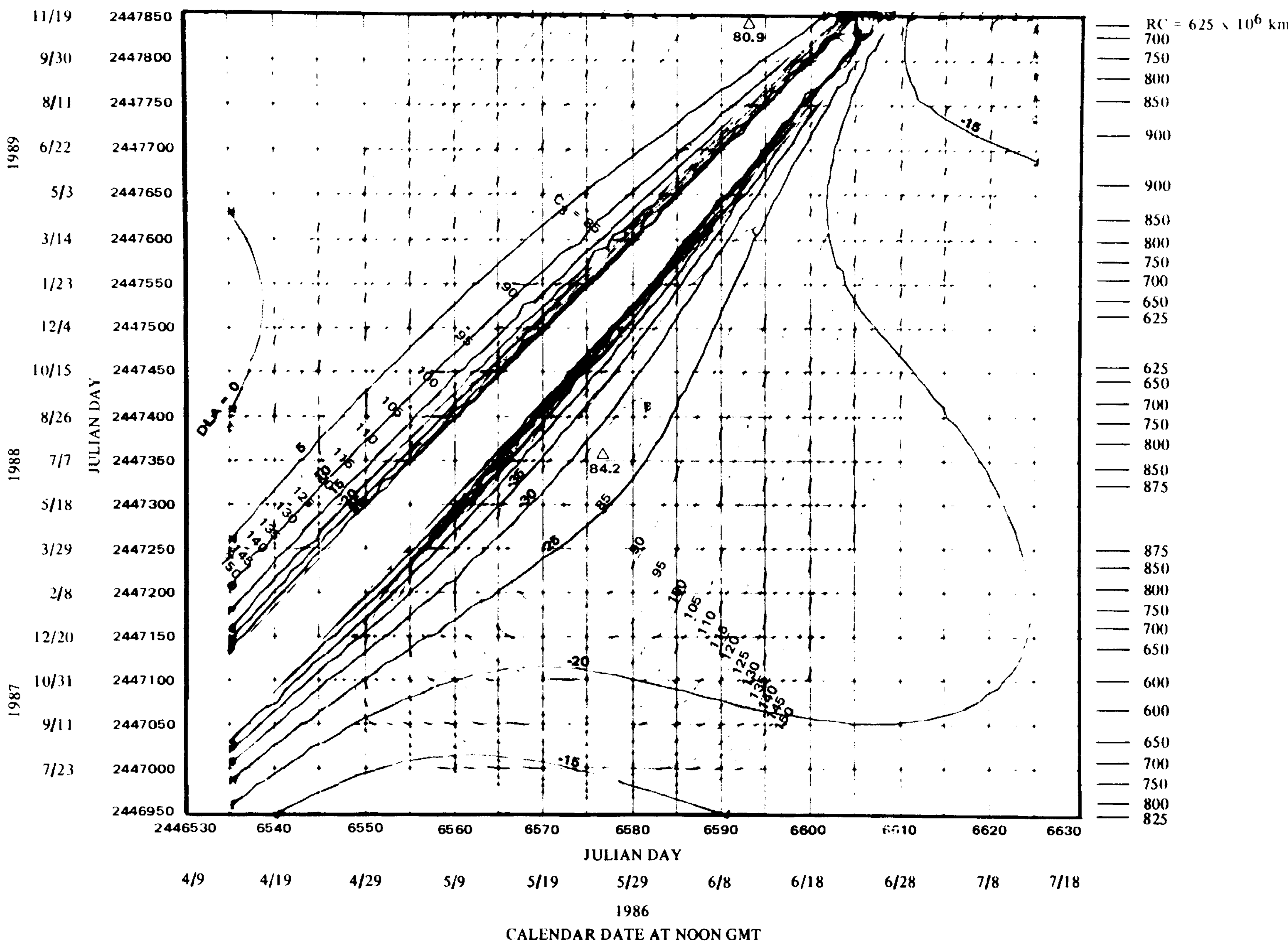
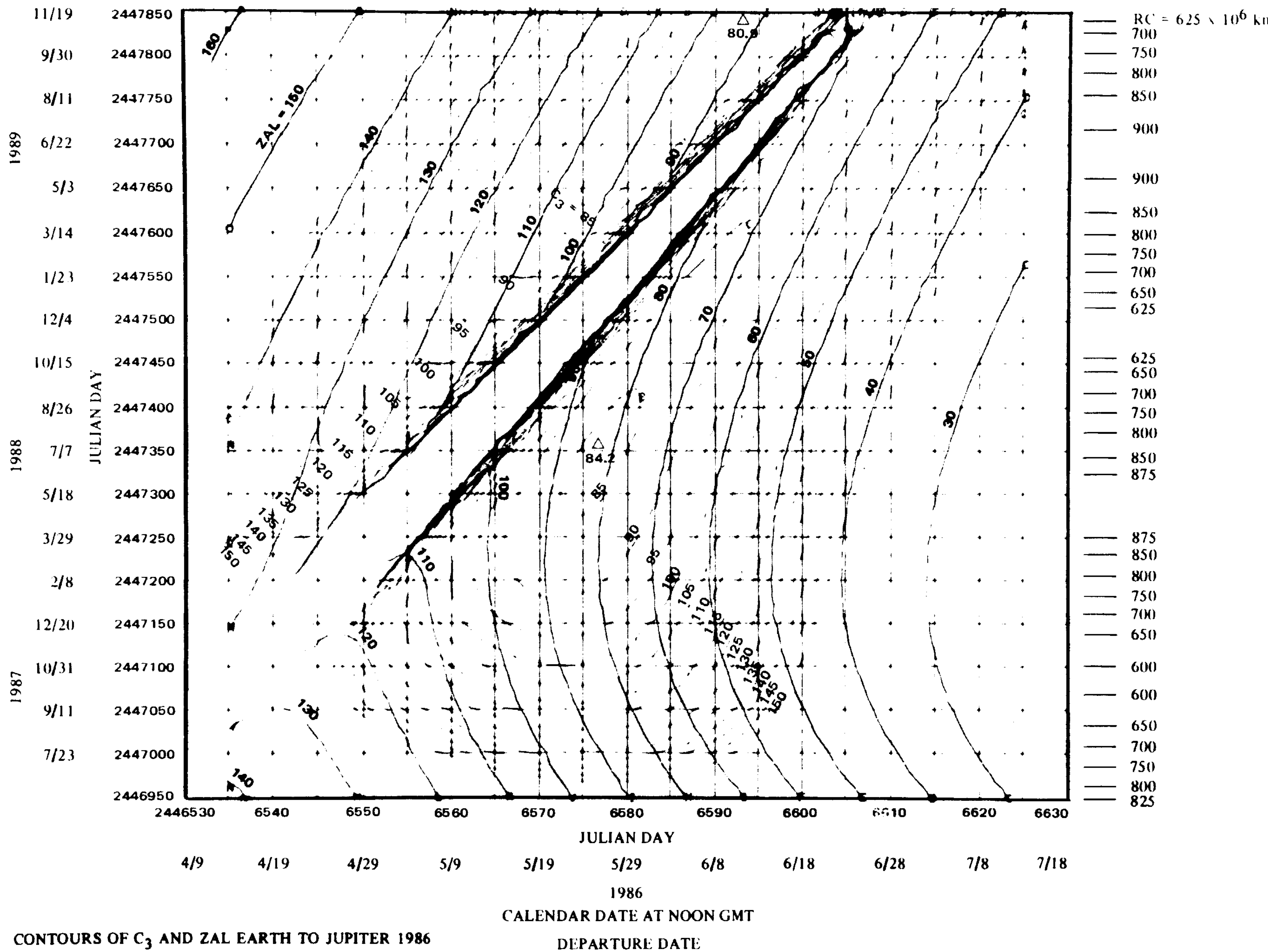


CONTOURS OF C_3 AND DLA EARTH TO JUPITER 1986

DEPARTURE DATE



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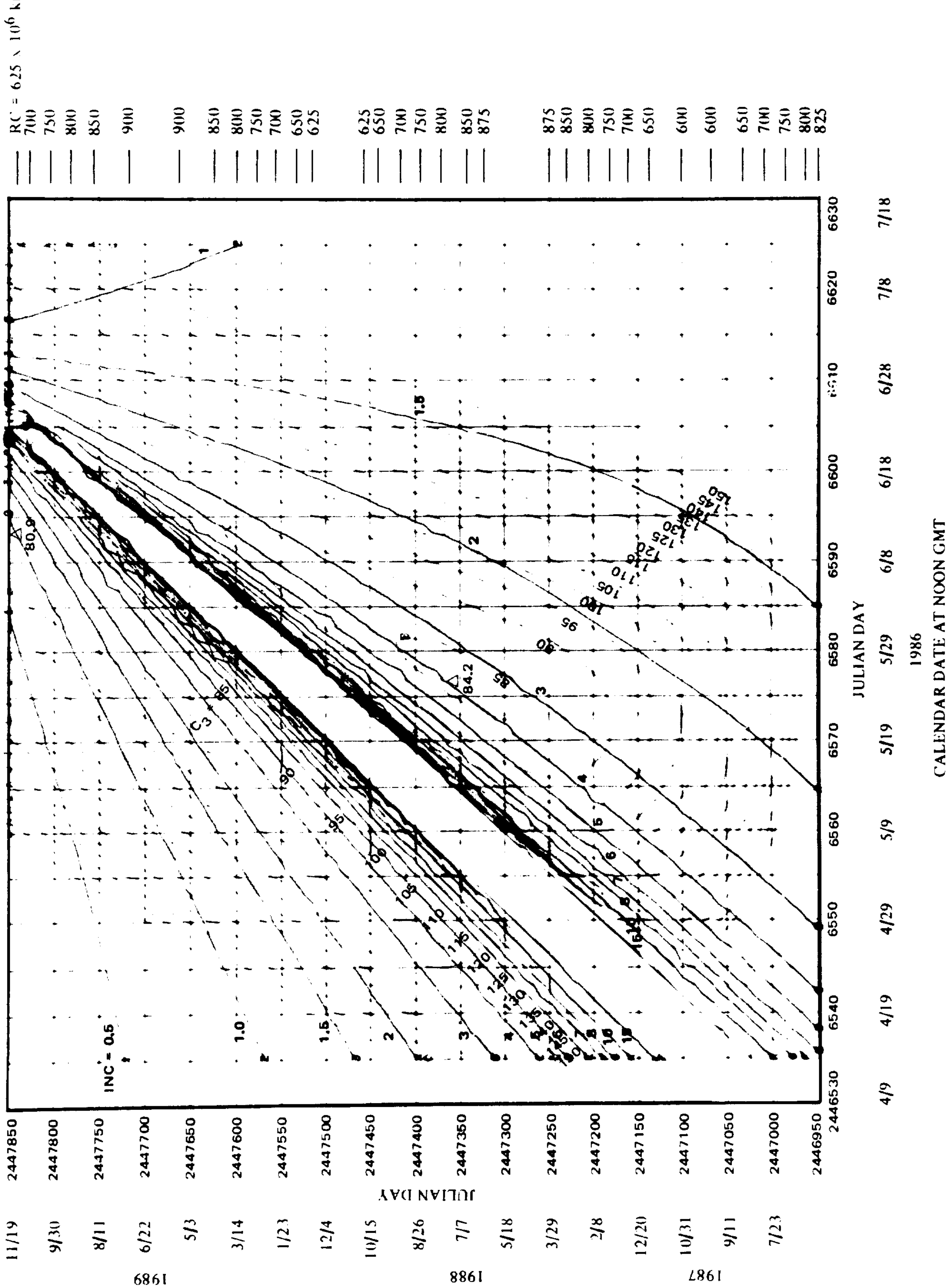

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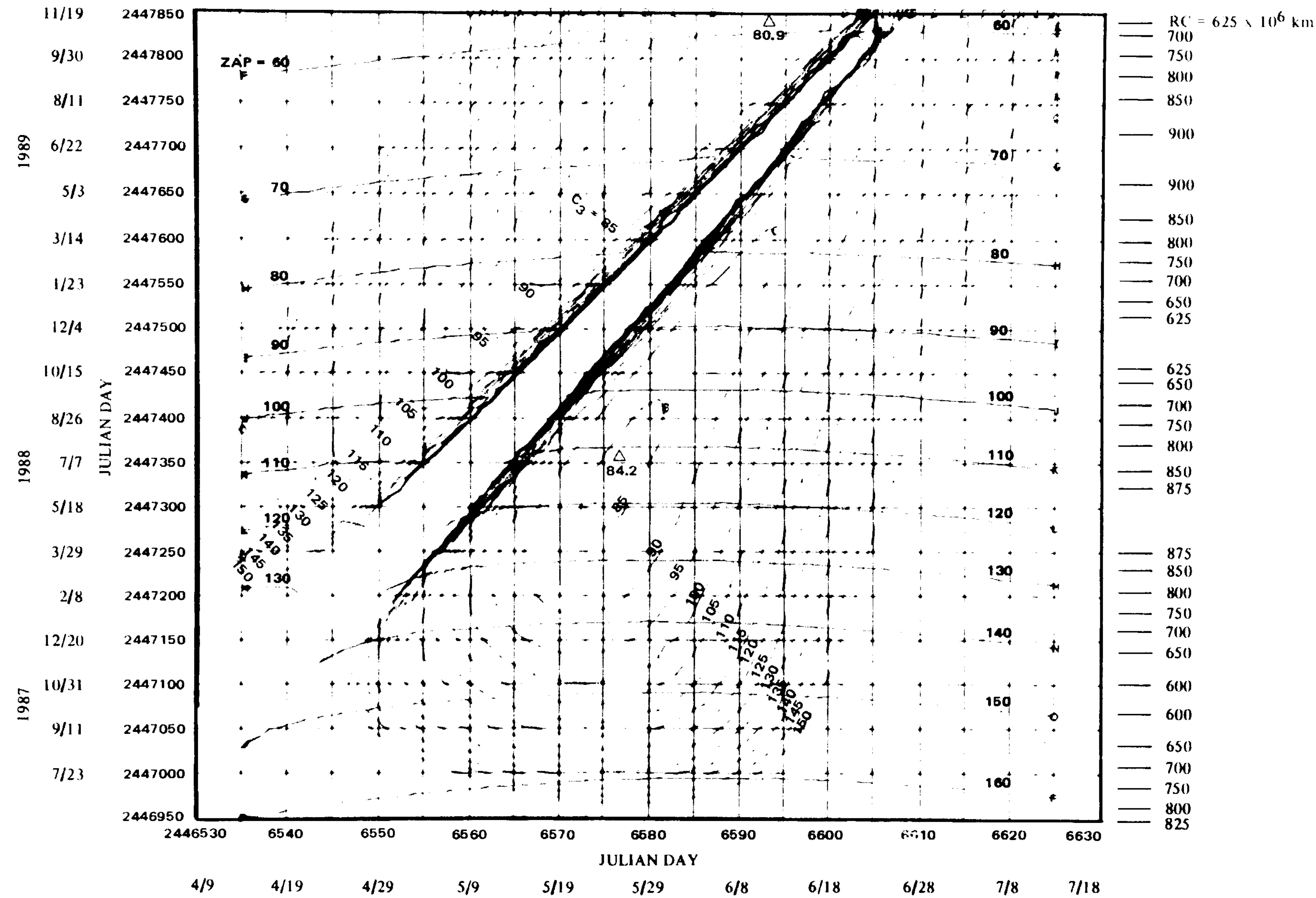
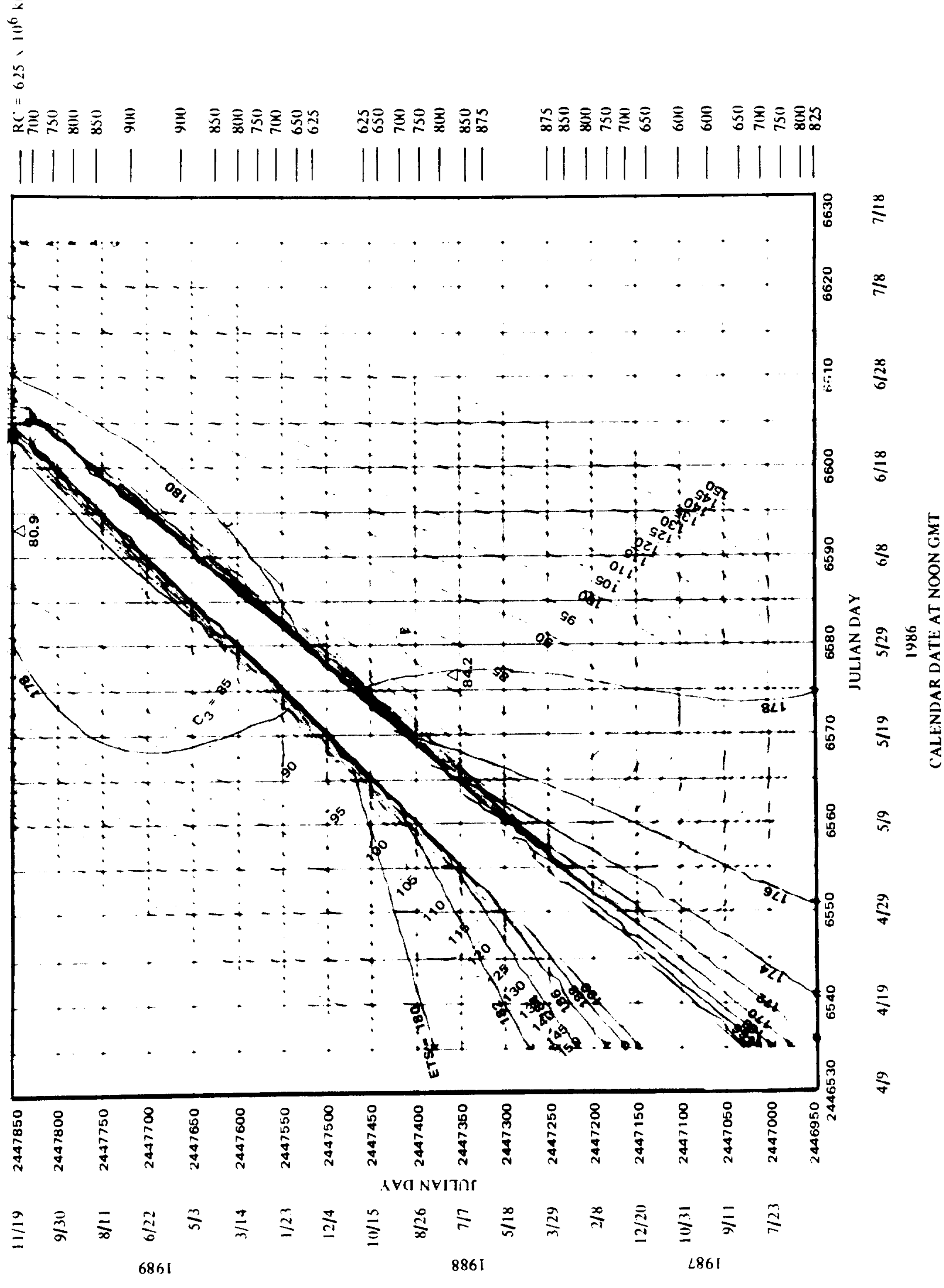


JULIAN DAY

1986
CALENDAR DATE AT NOON GMT
DEPARTURE DATE

CONTOURS OF C_3 AND ZAP EARTH TO JUPITER 1986



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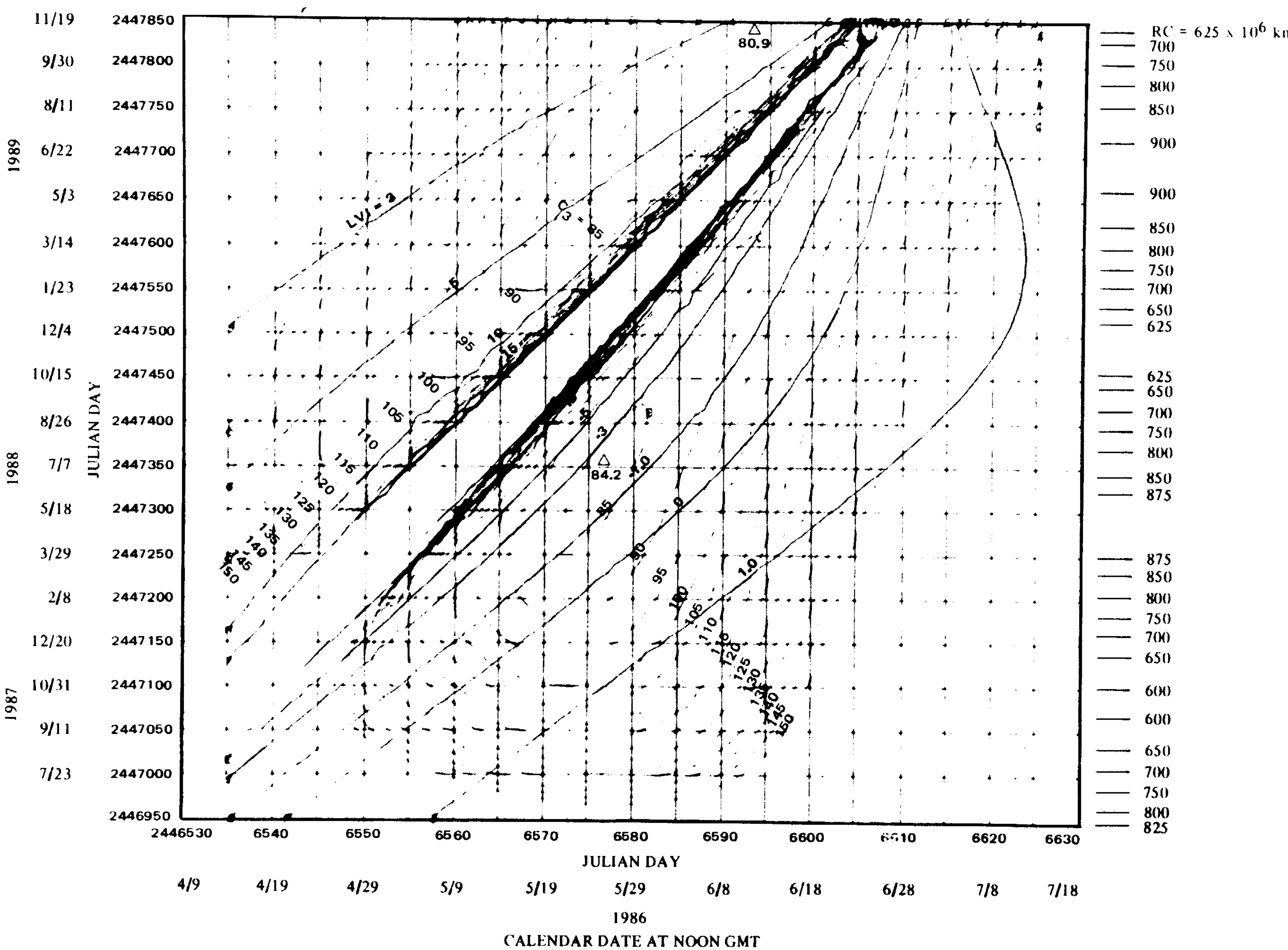

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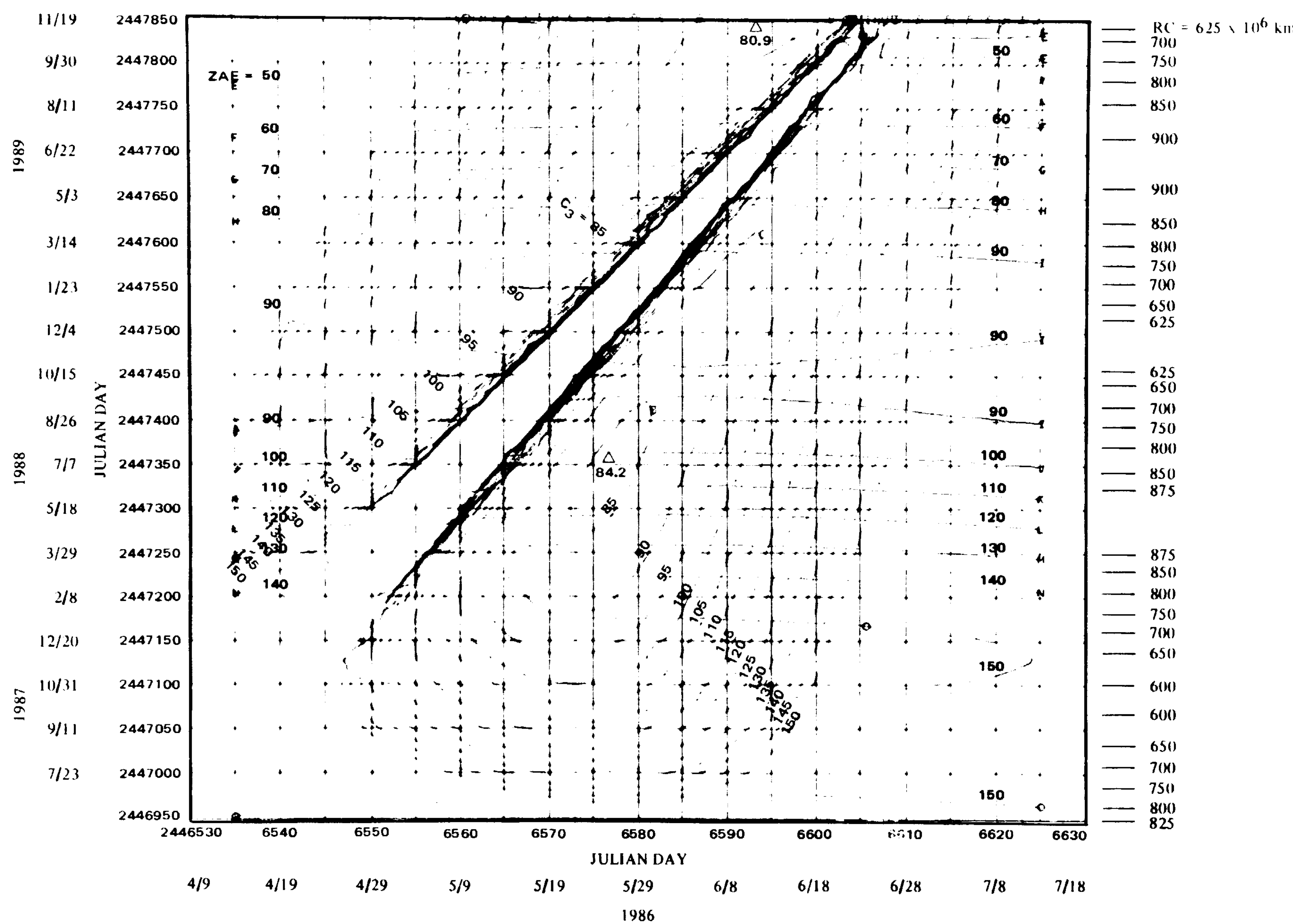

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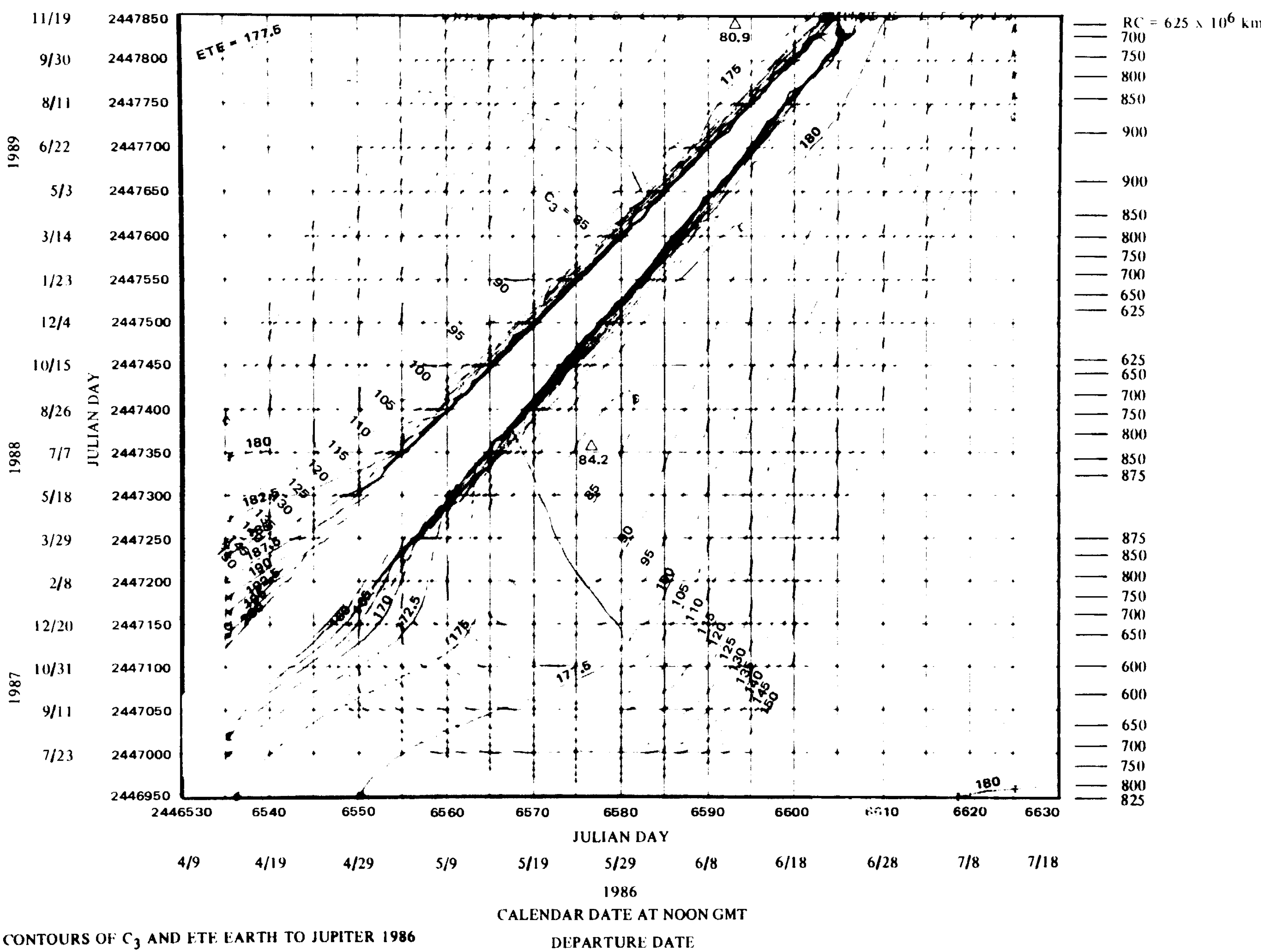
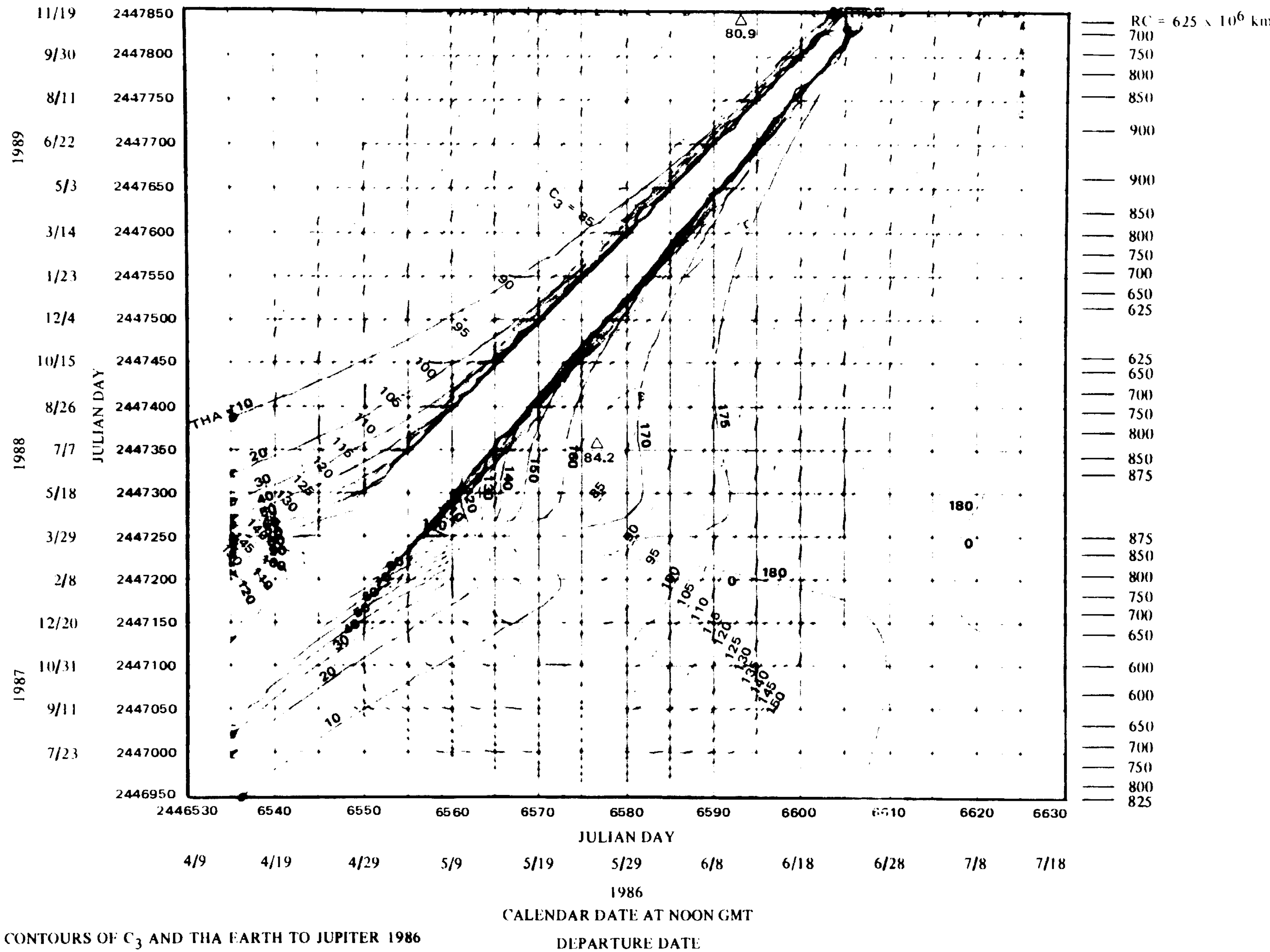


CONTOURS OF C_3 AND ETE EARTH TO JUPITER 1986

ET 2 19



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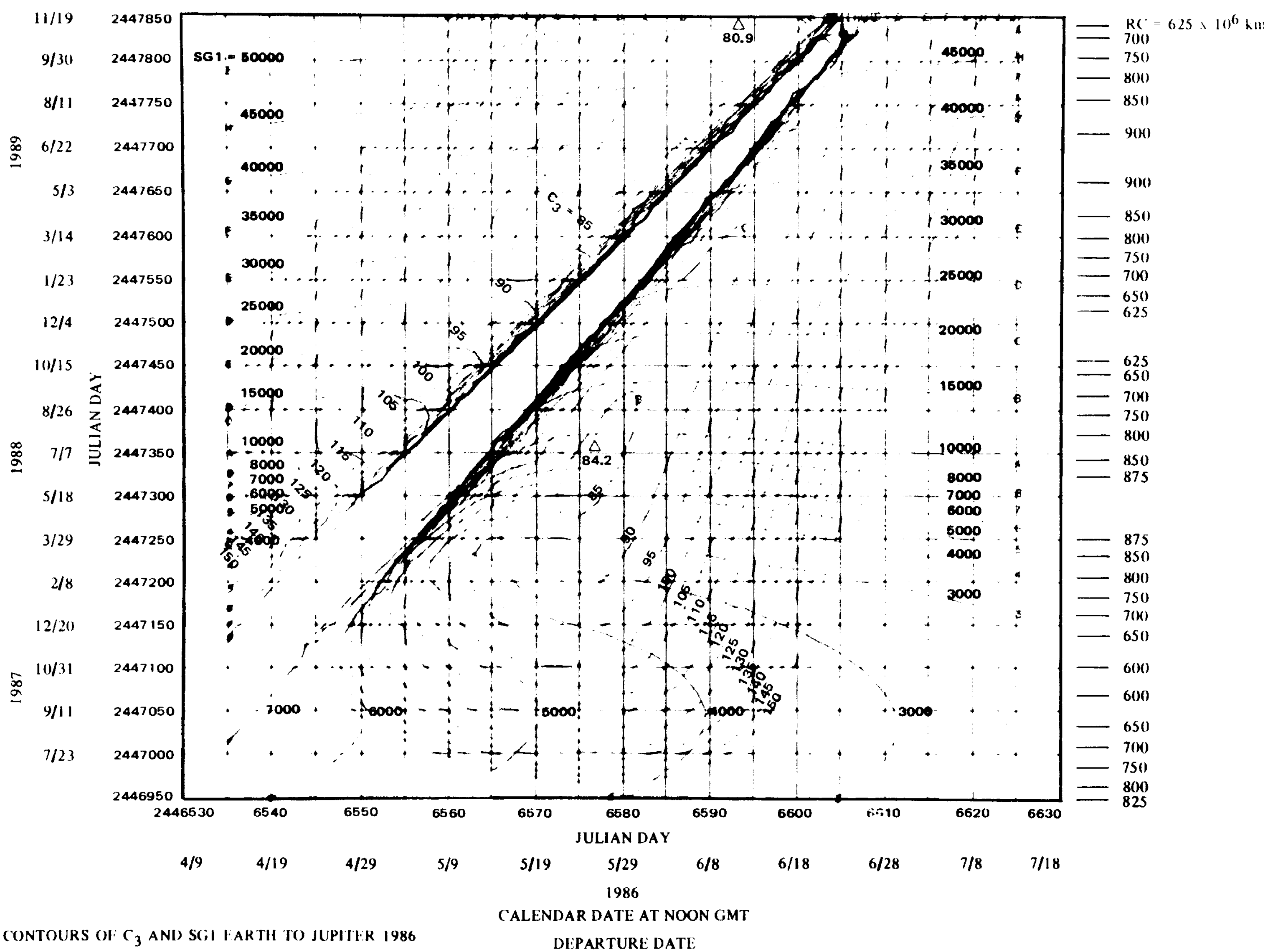
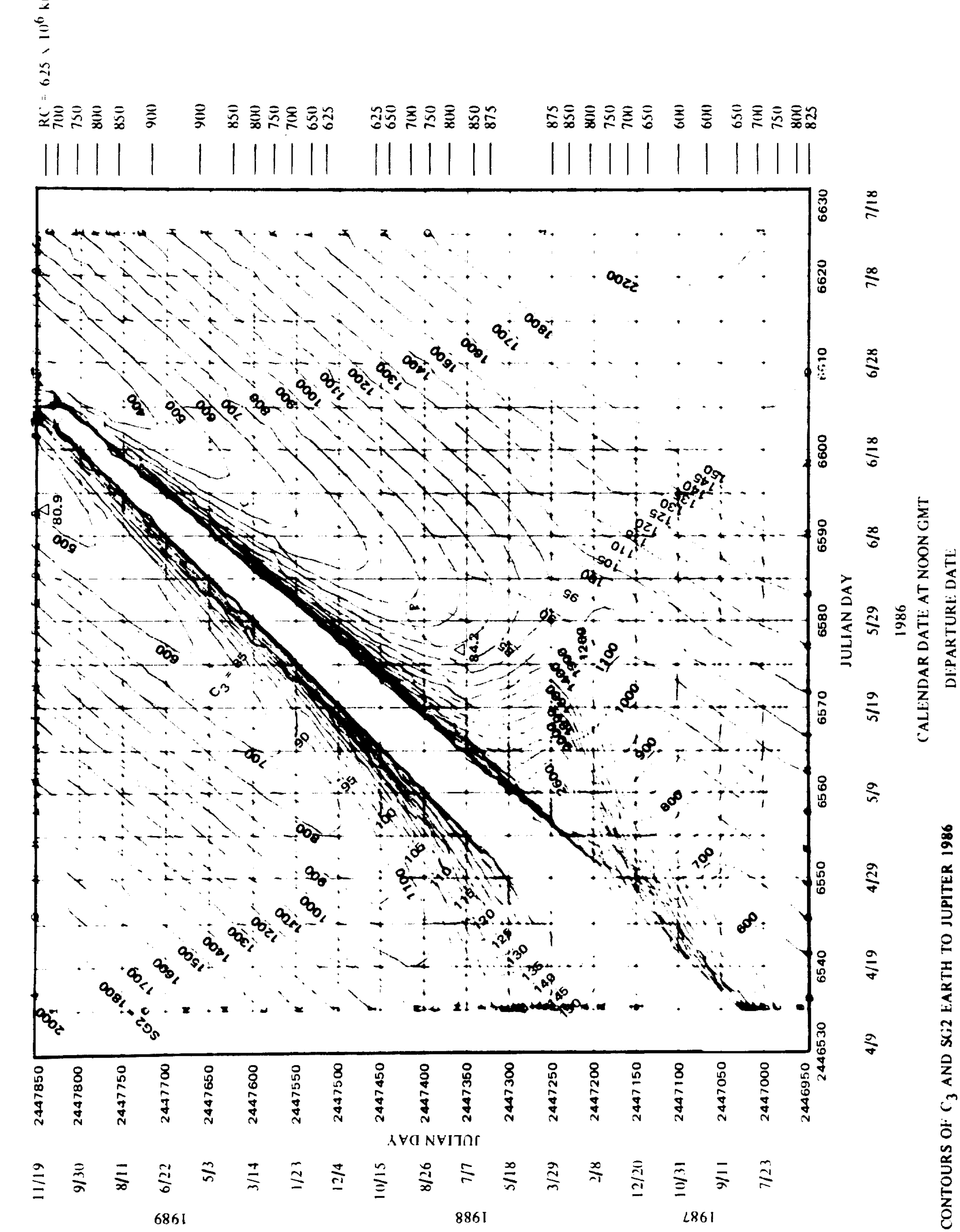


CONTOURS OF C_3 AND SG1 EARTH TO JUPITER 1986

SC 2 19



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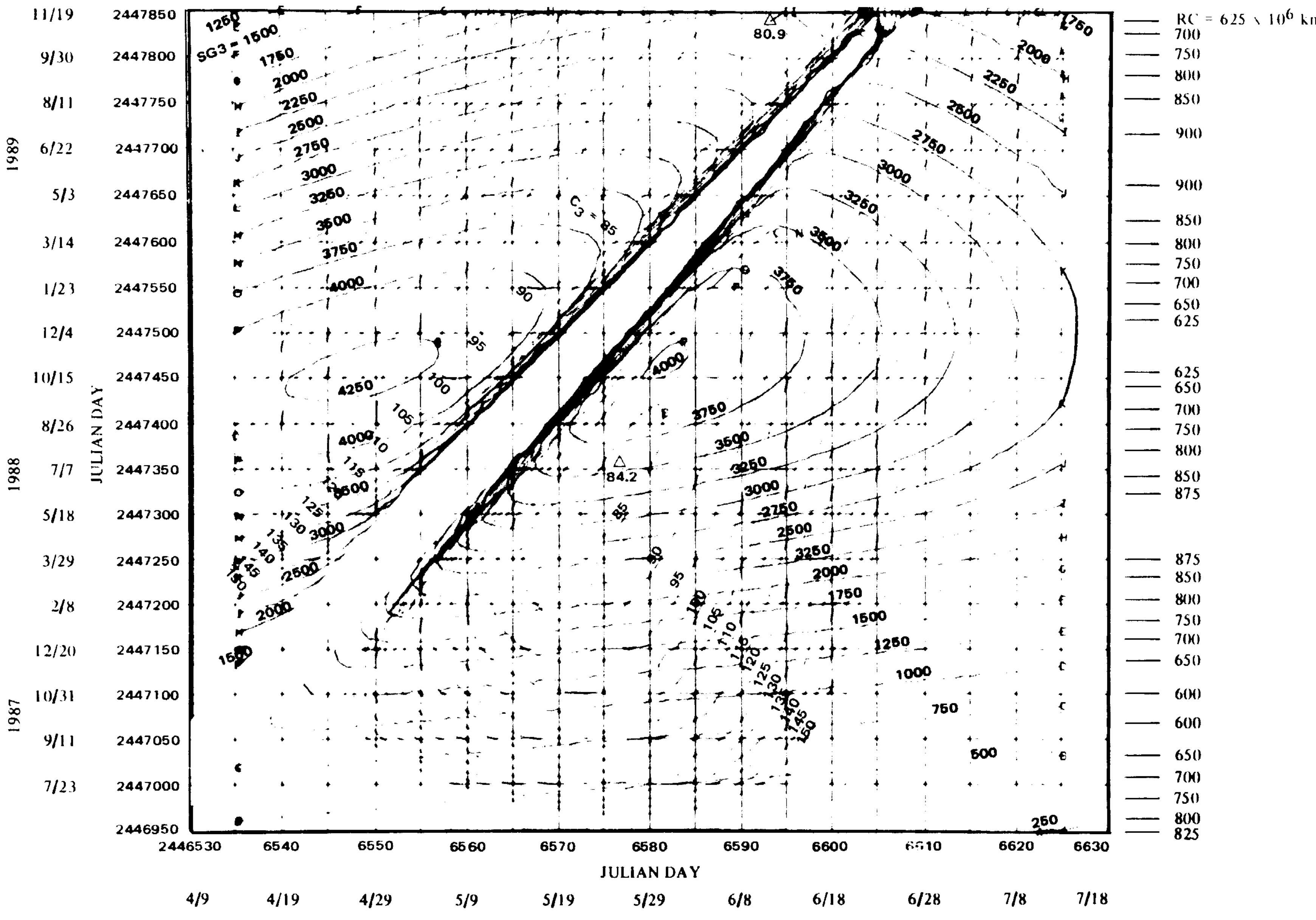

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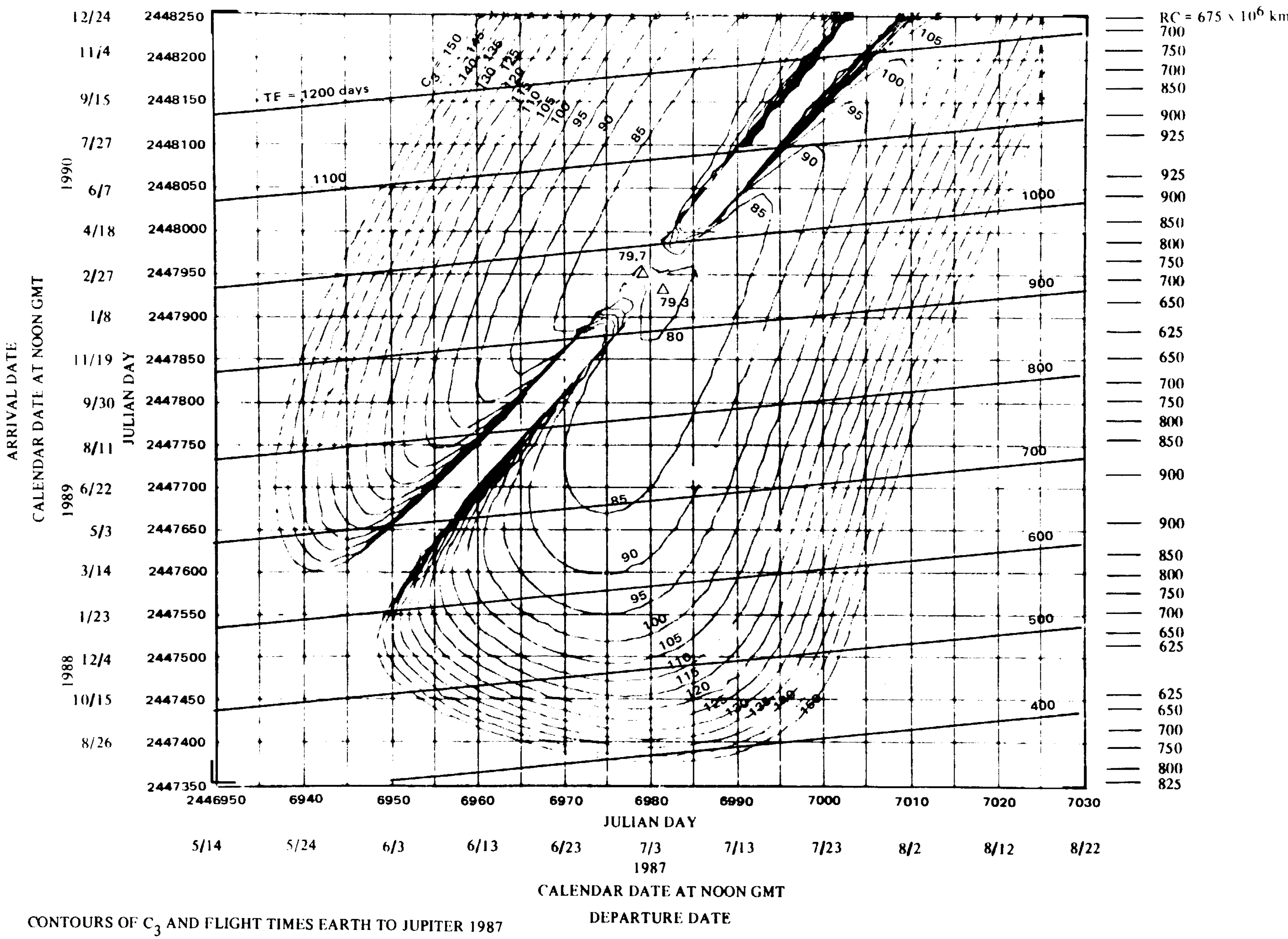
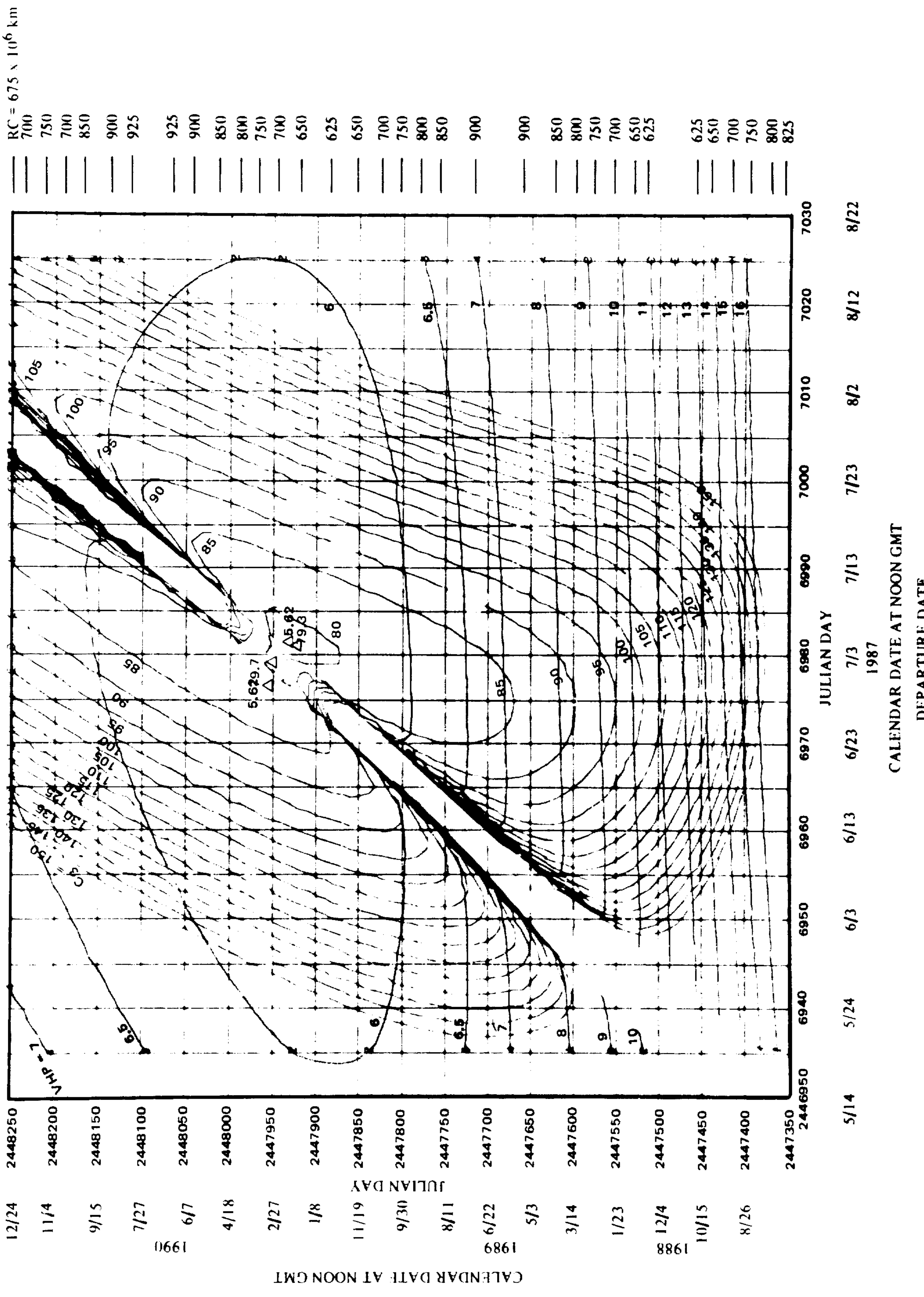


CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1987



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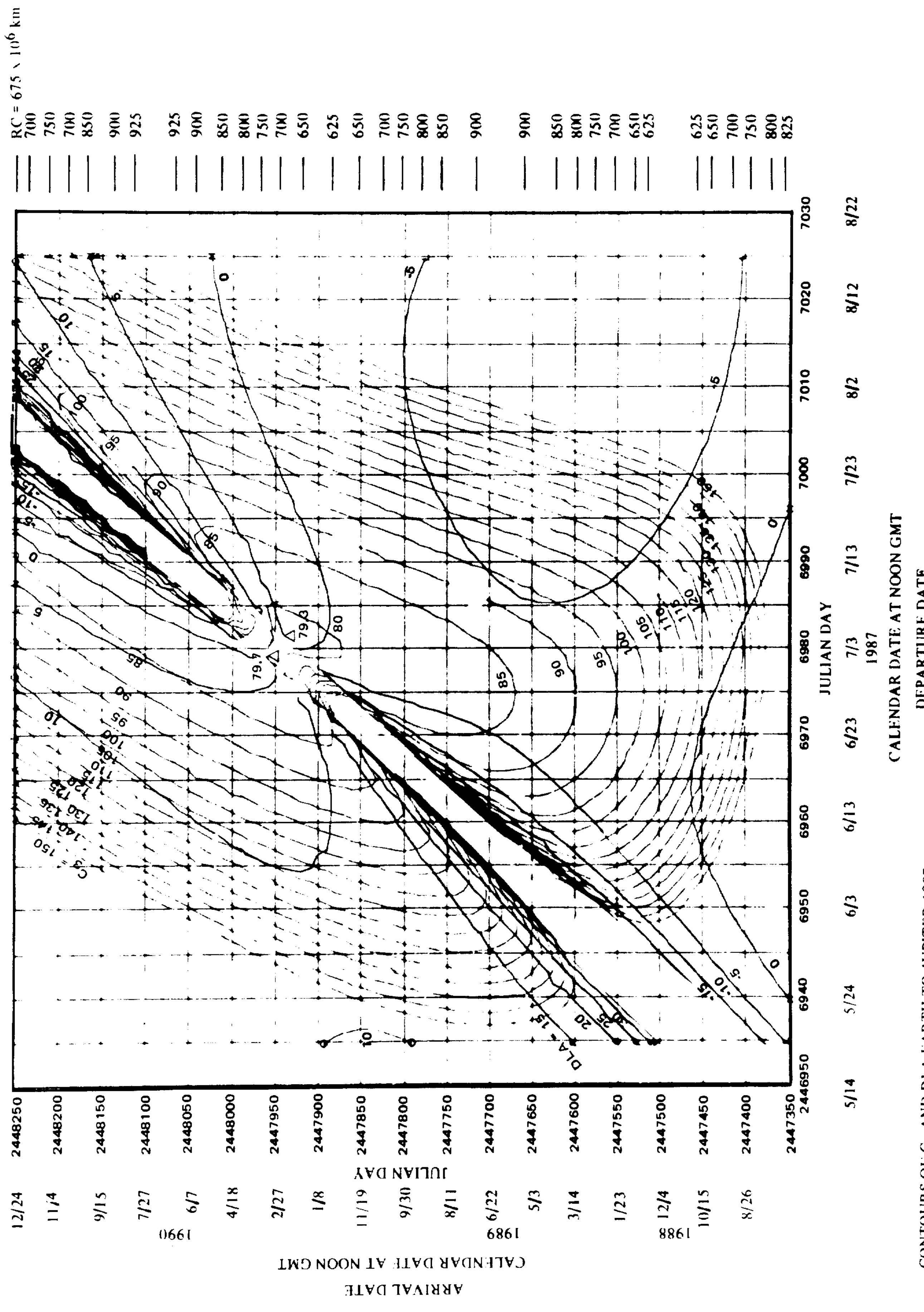

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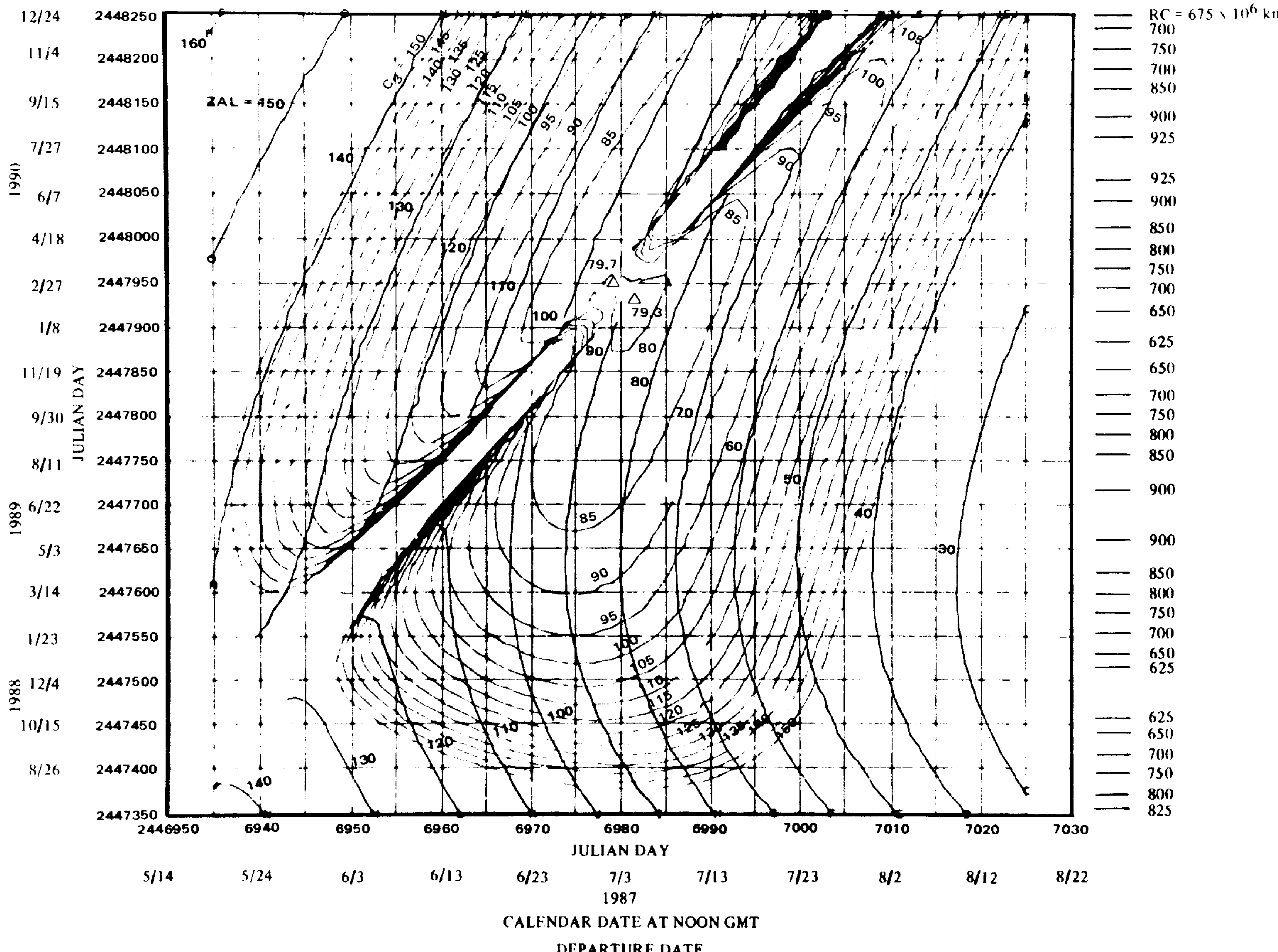

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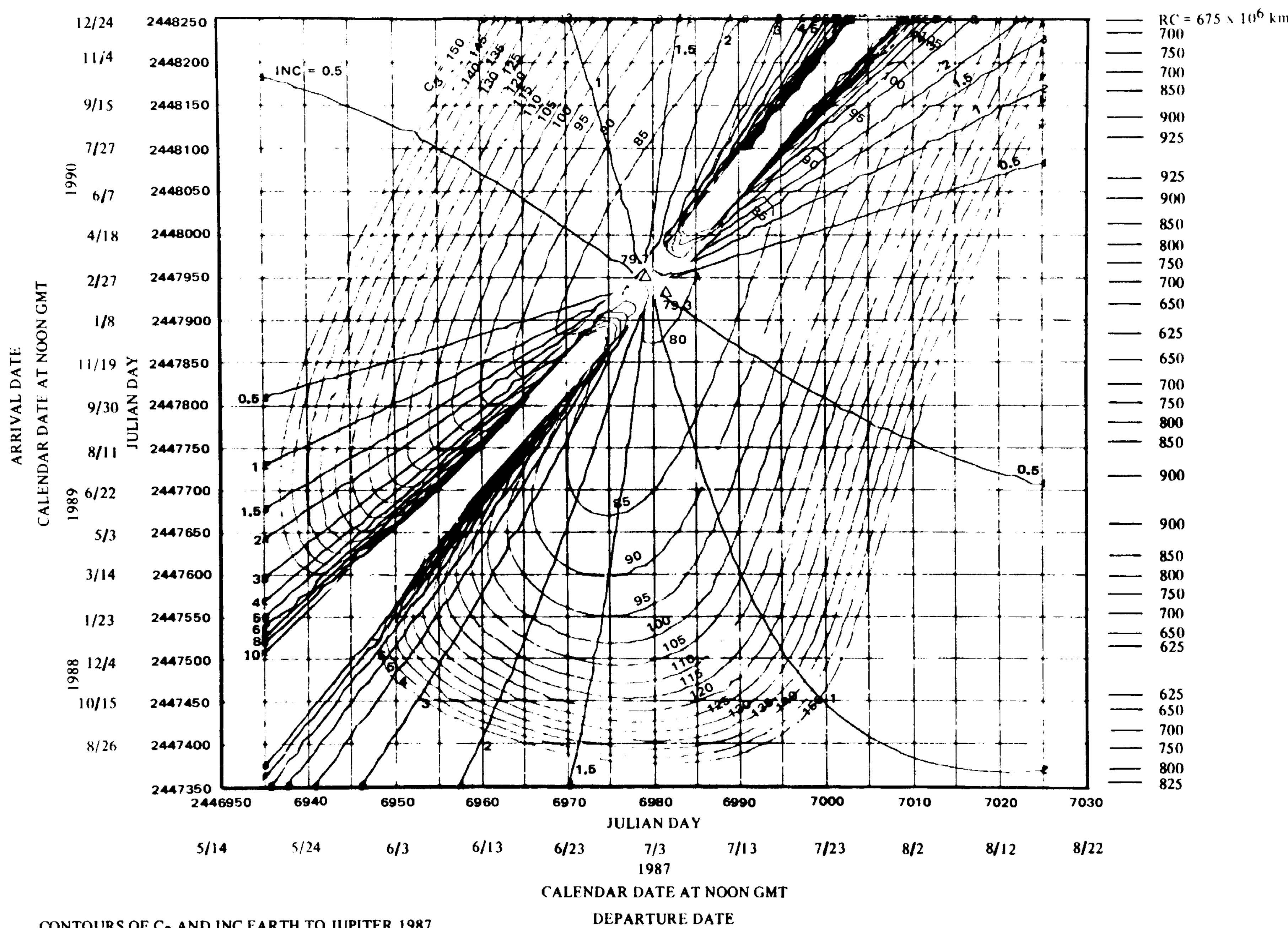

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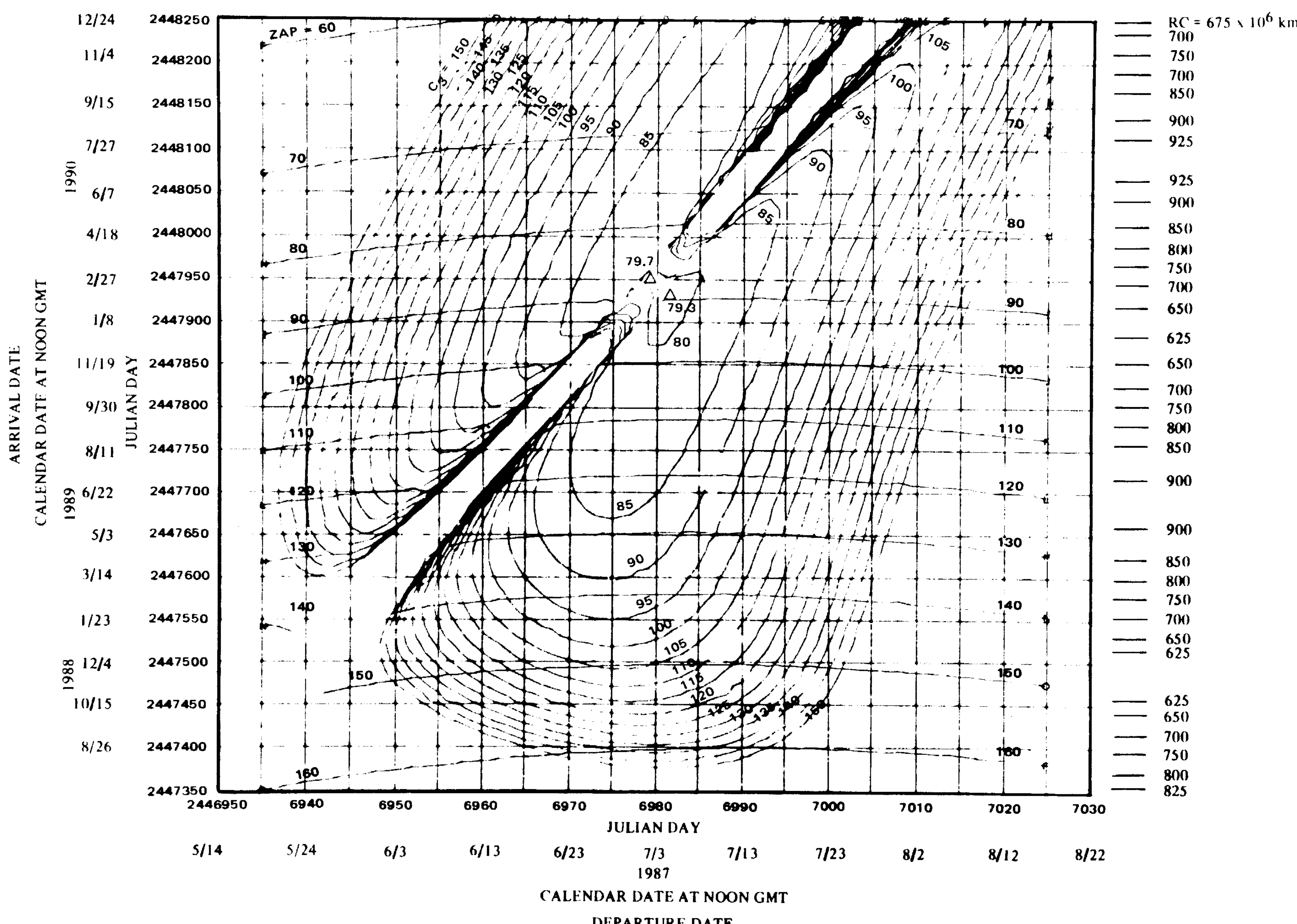

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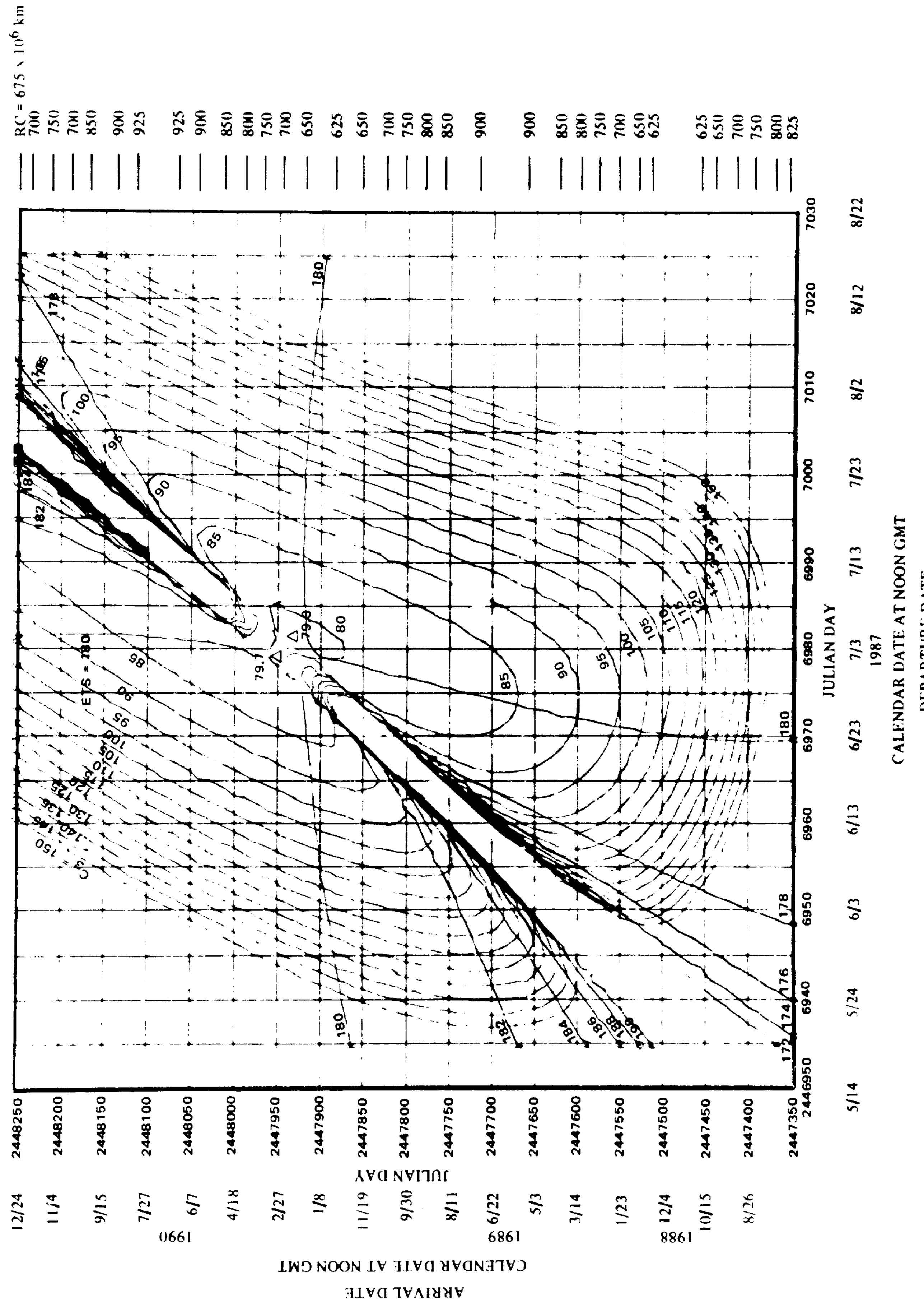

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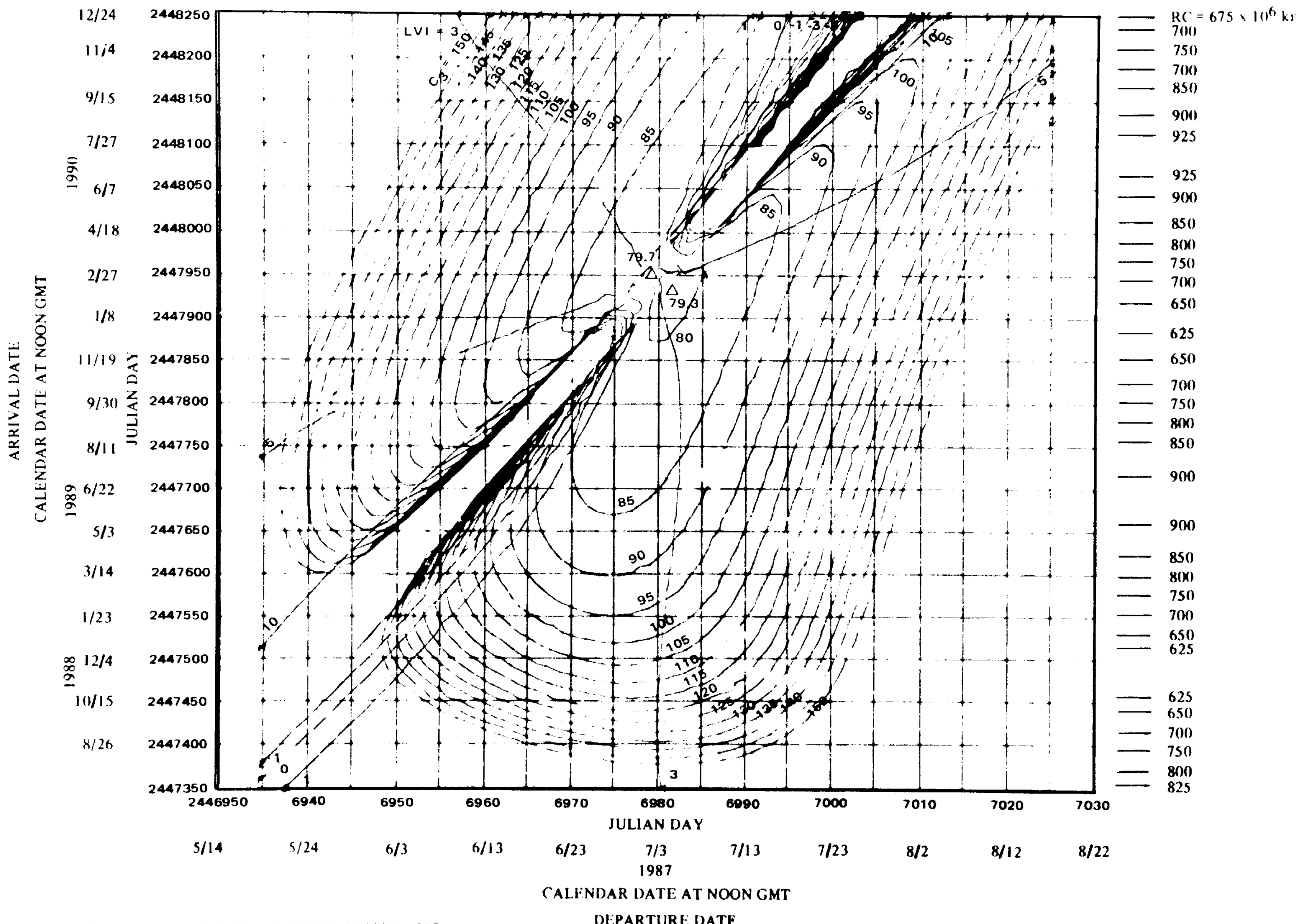

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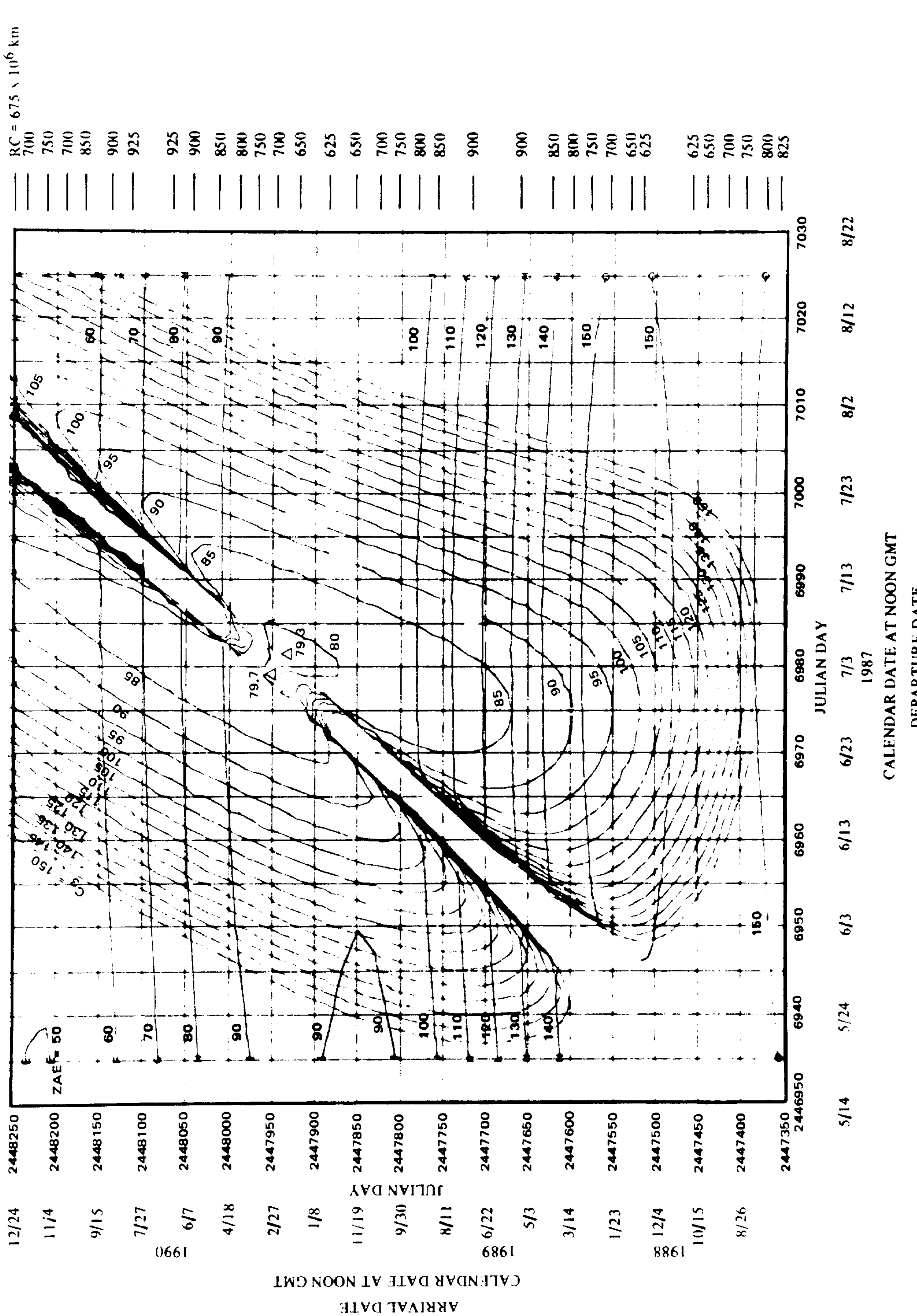

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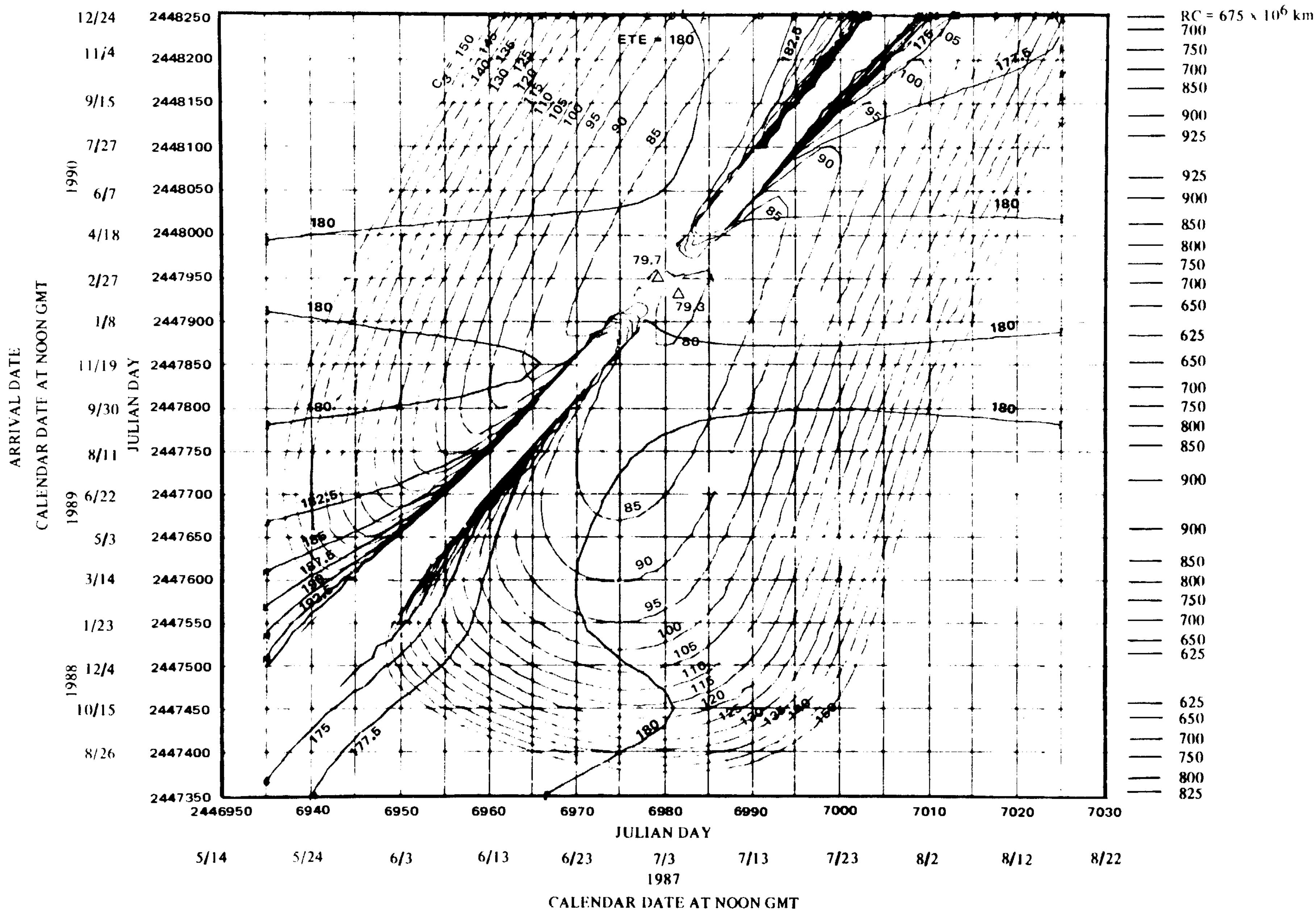
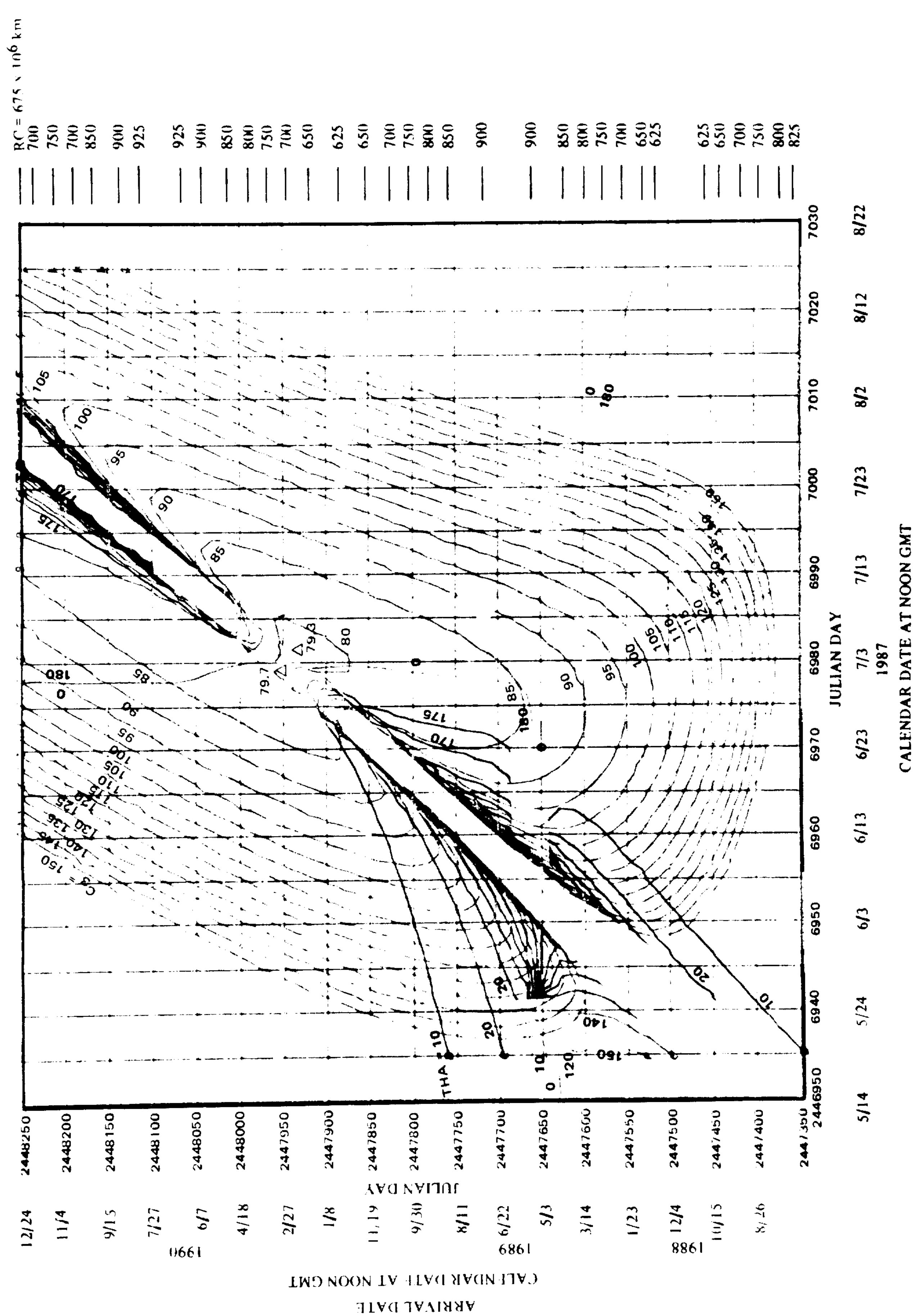


CONTOURS OF C_3 AND ETE EARTH TO JUPITER 1987

E1 19



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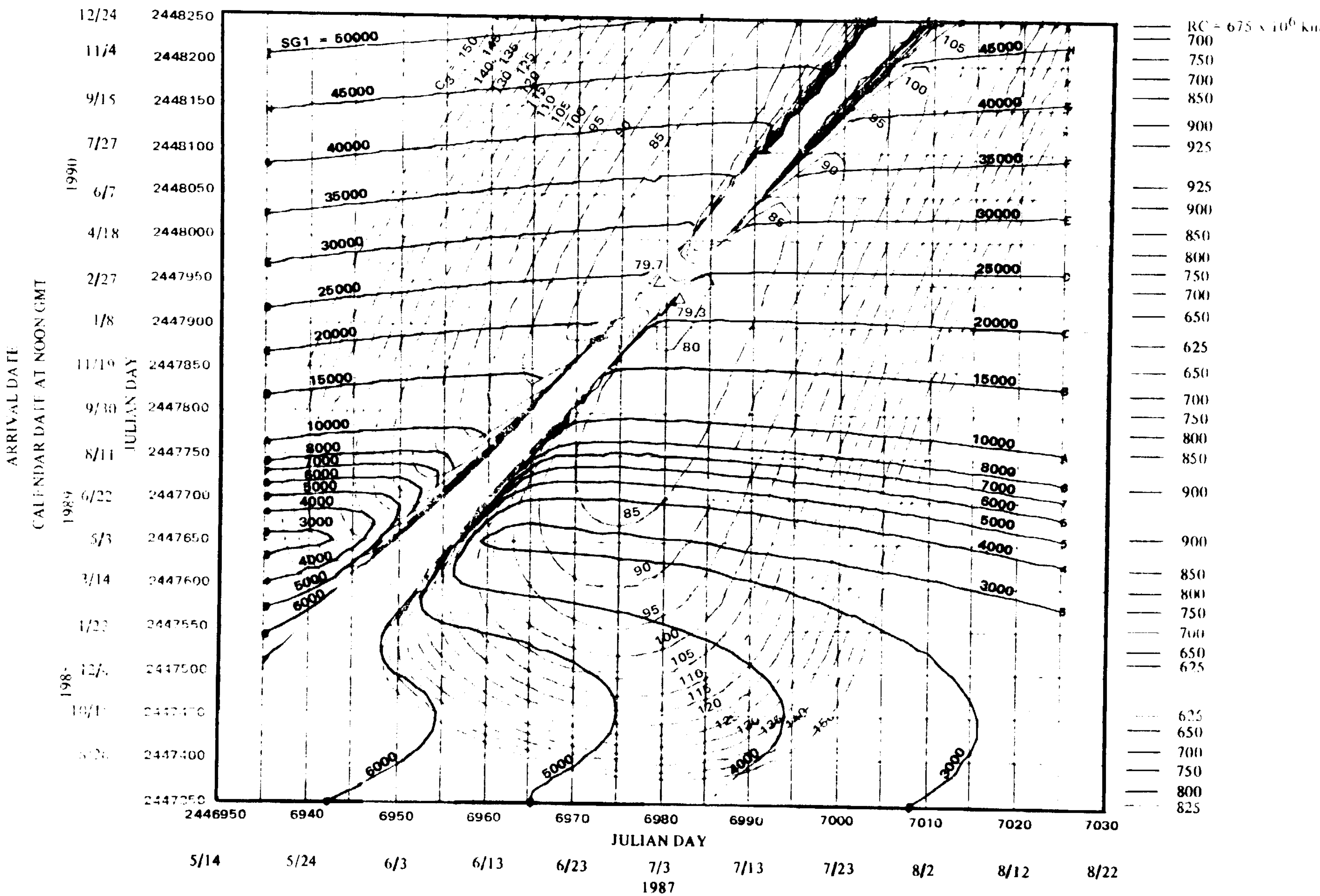

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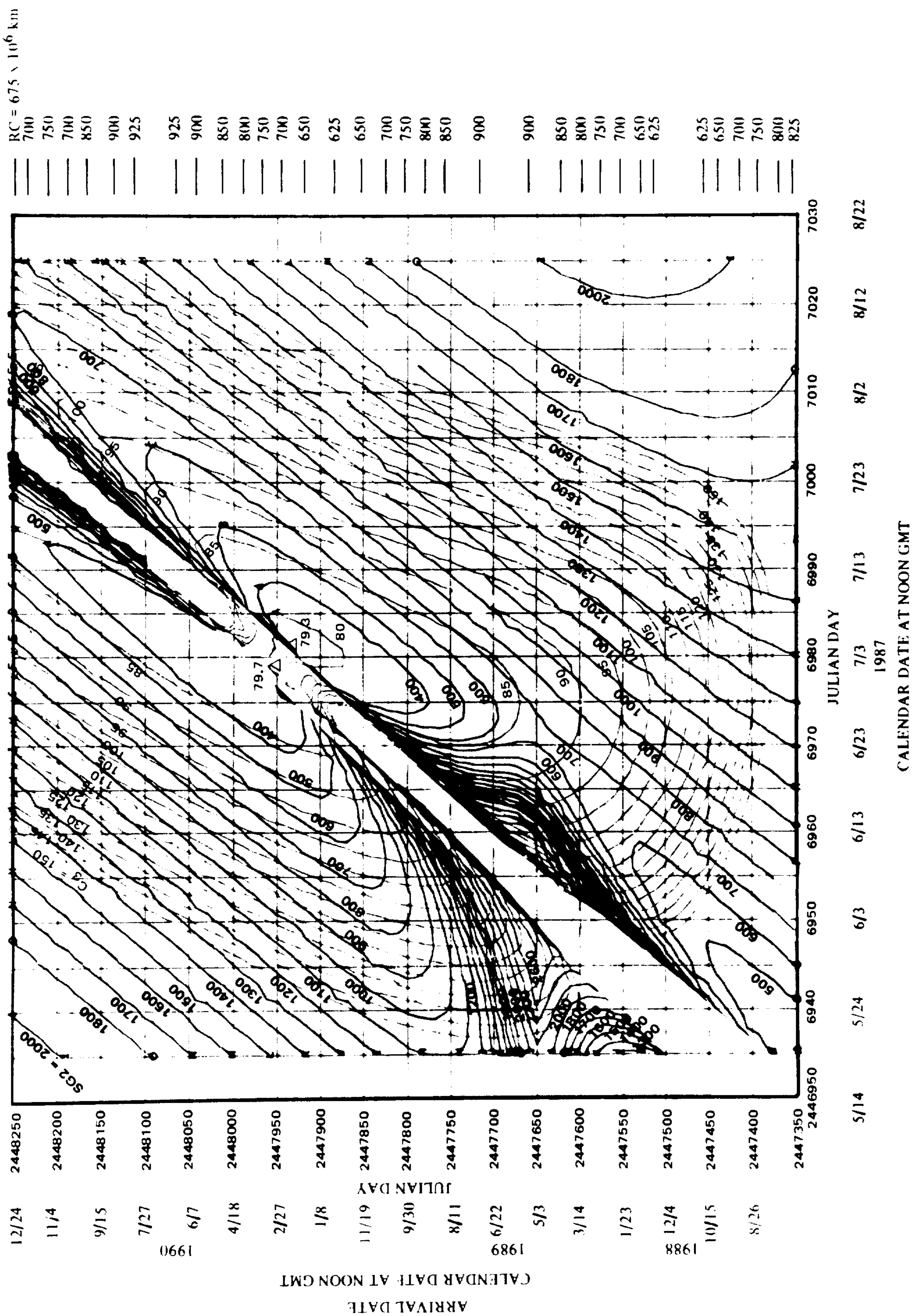

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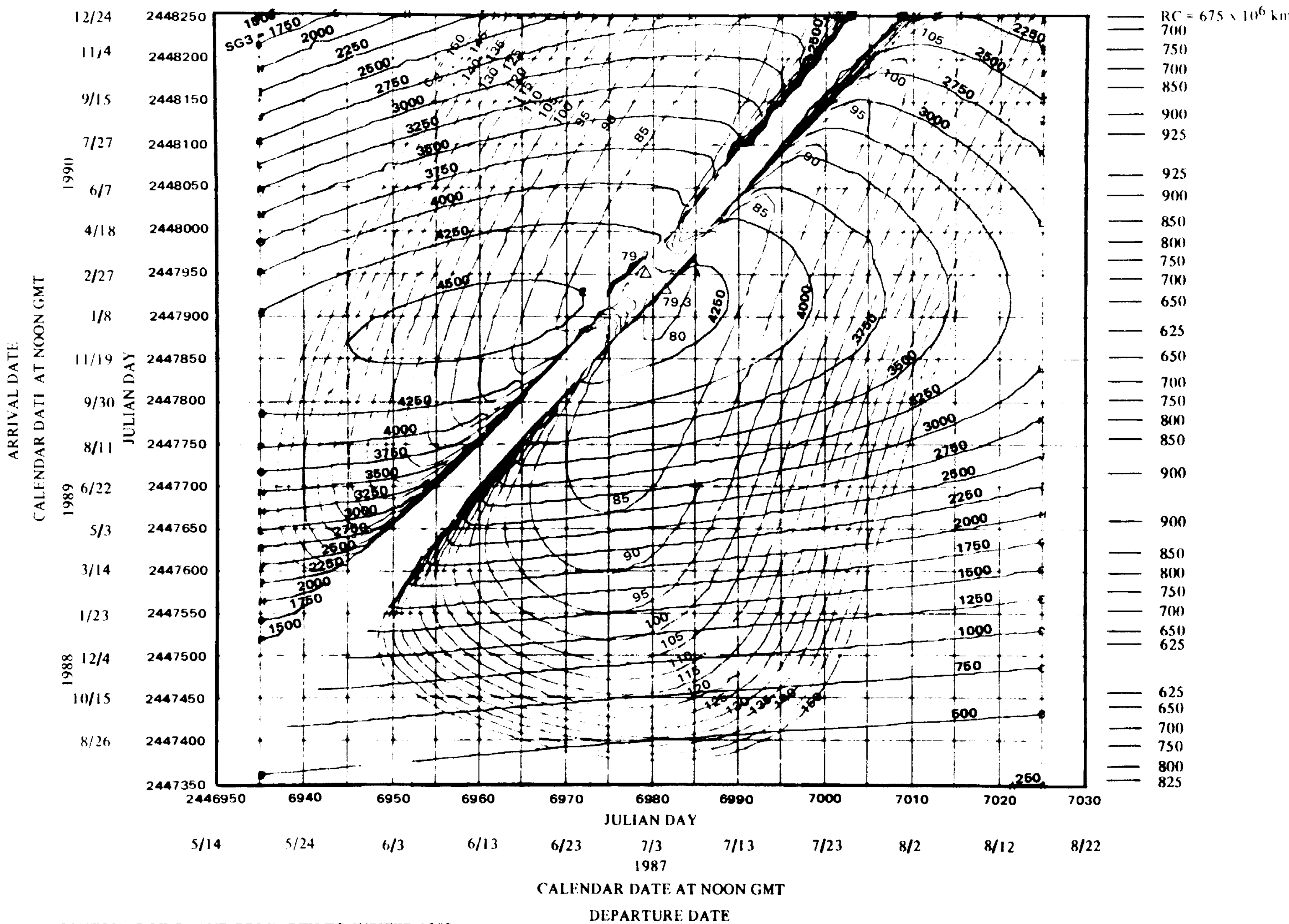
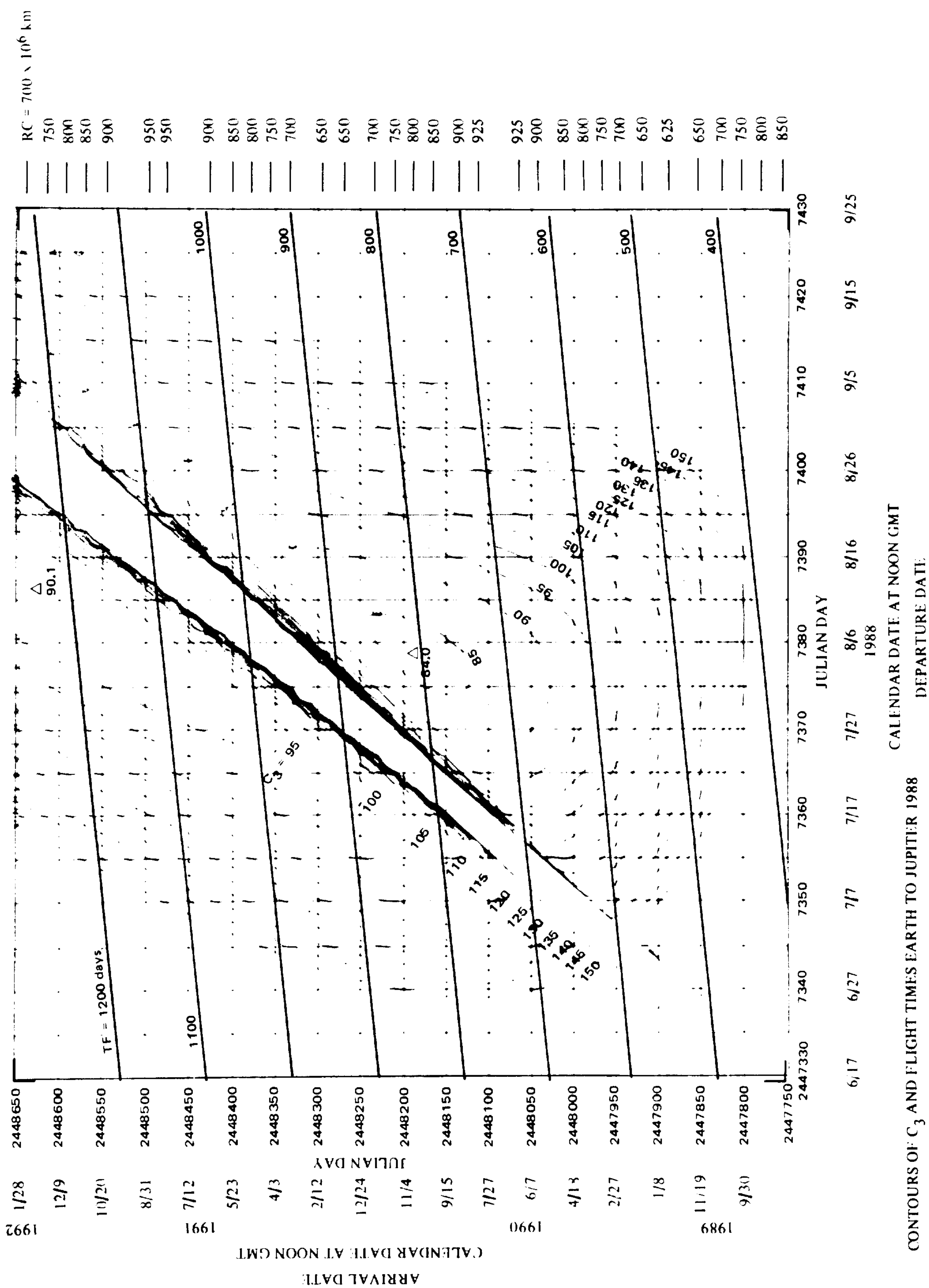
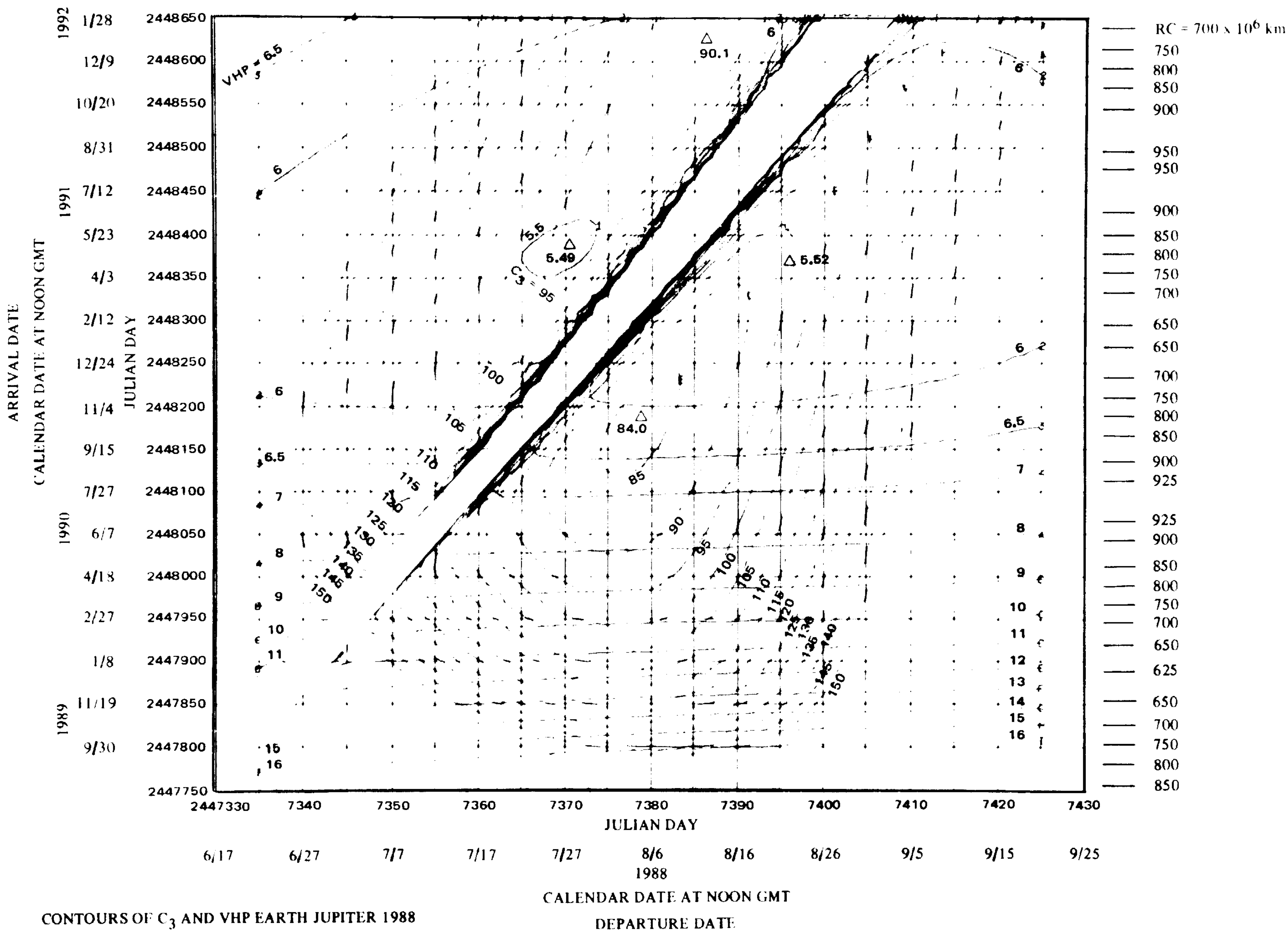


CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1987

SC 2 19



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1988



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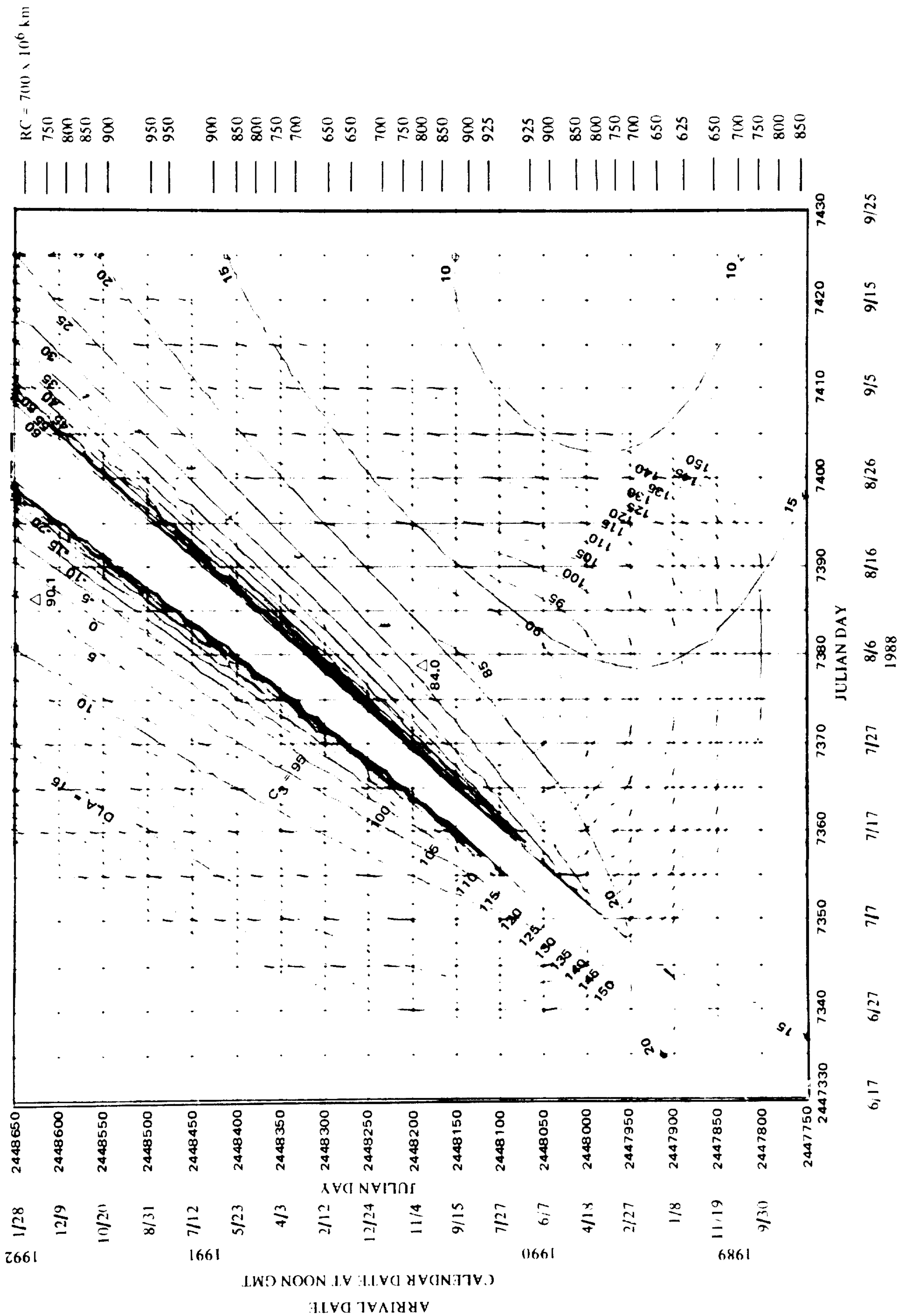

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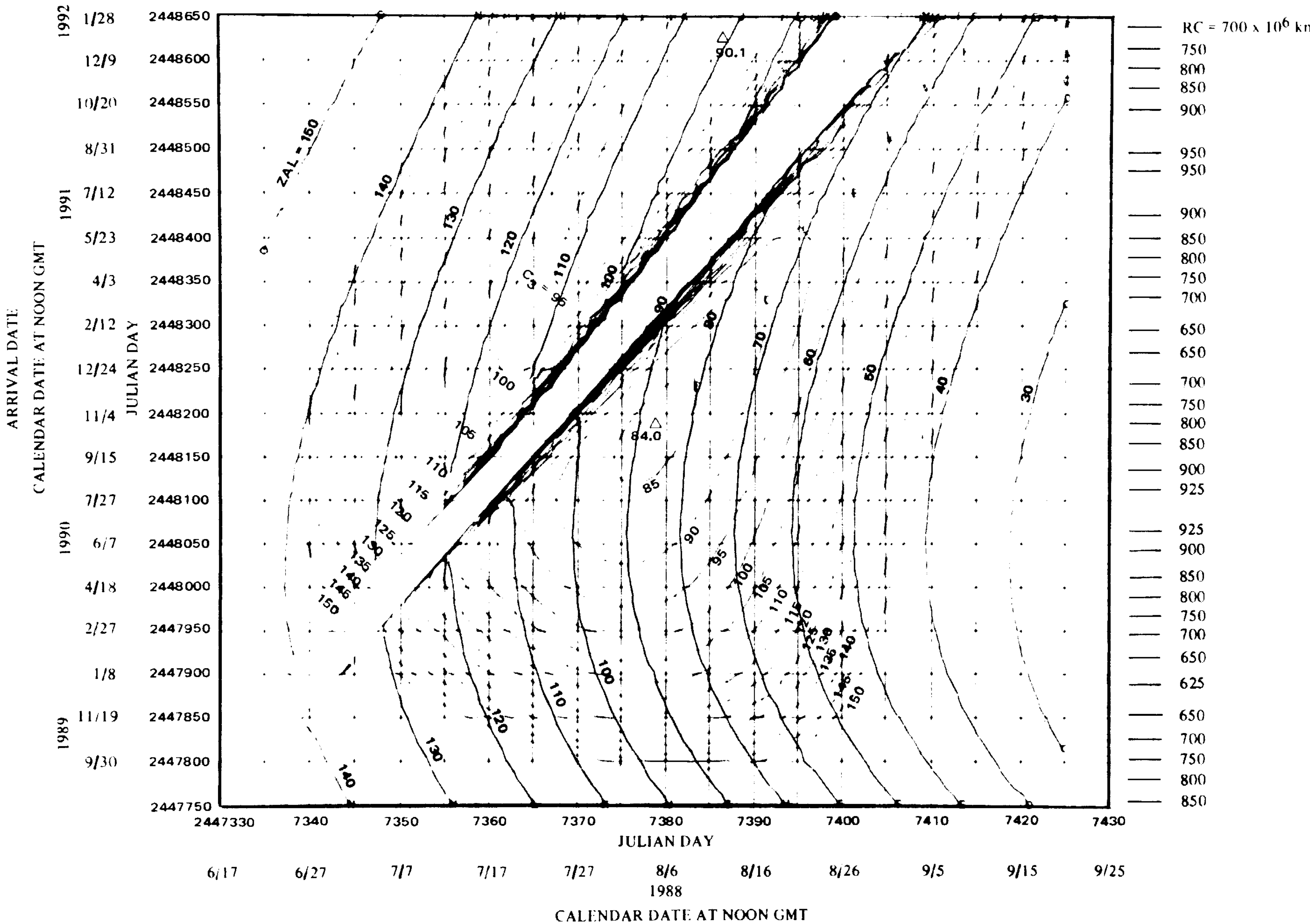

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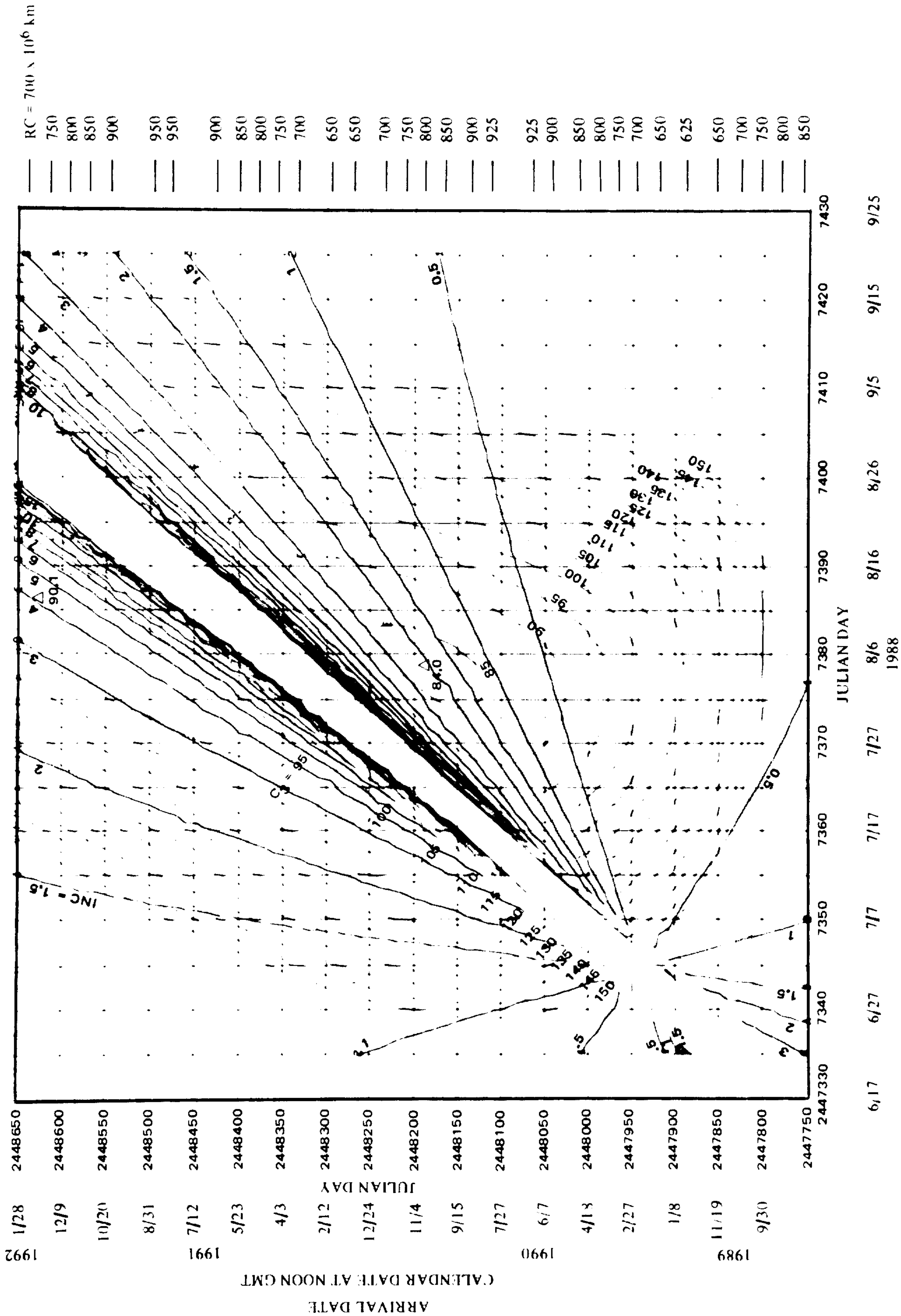

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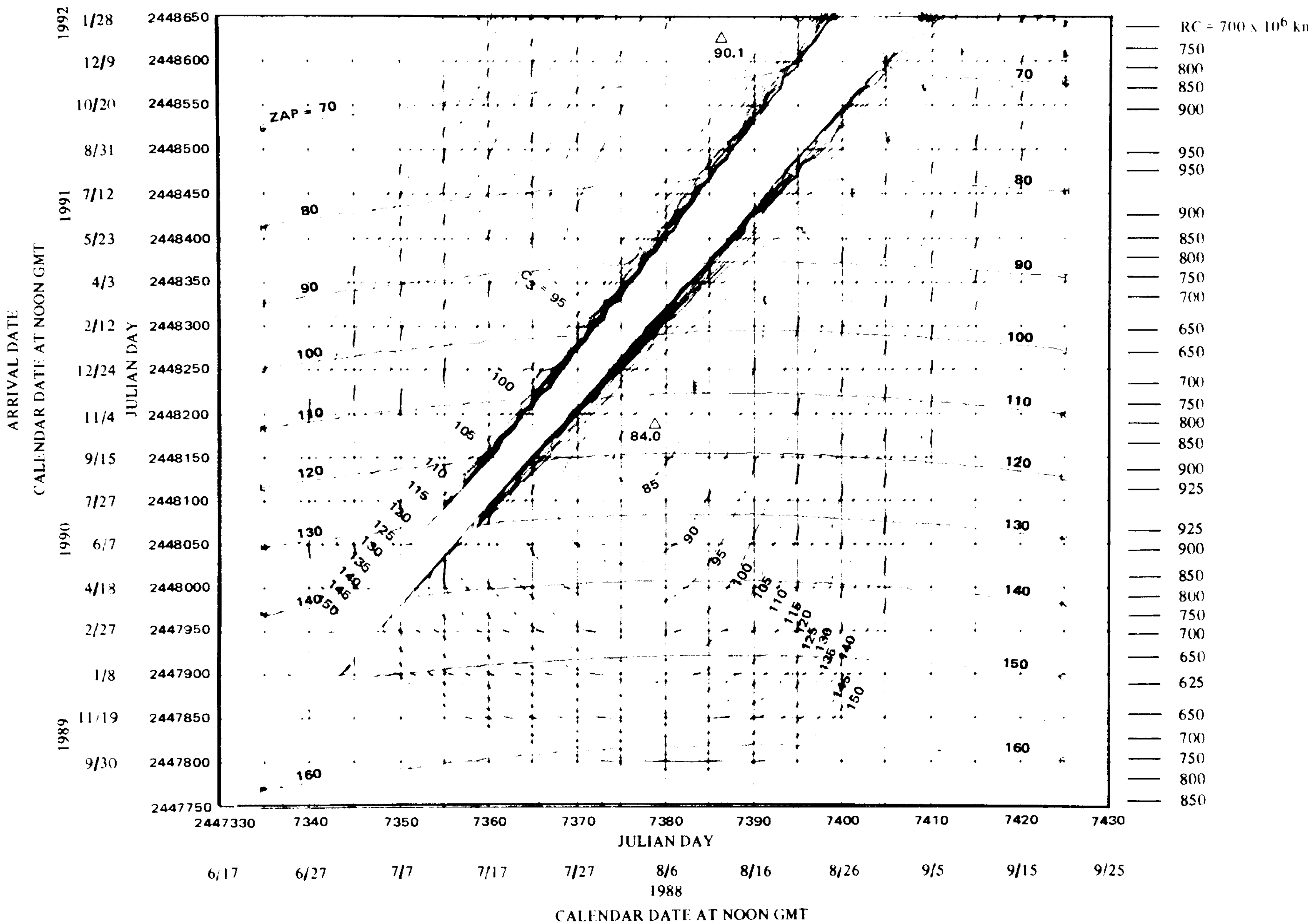

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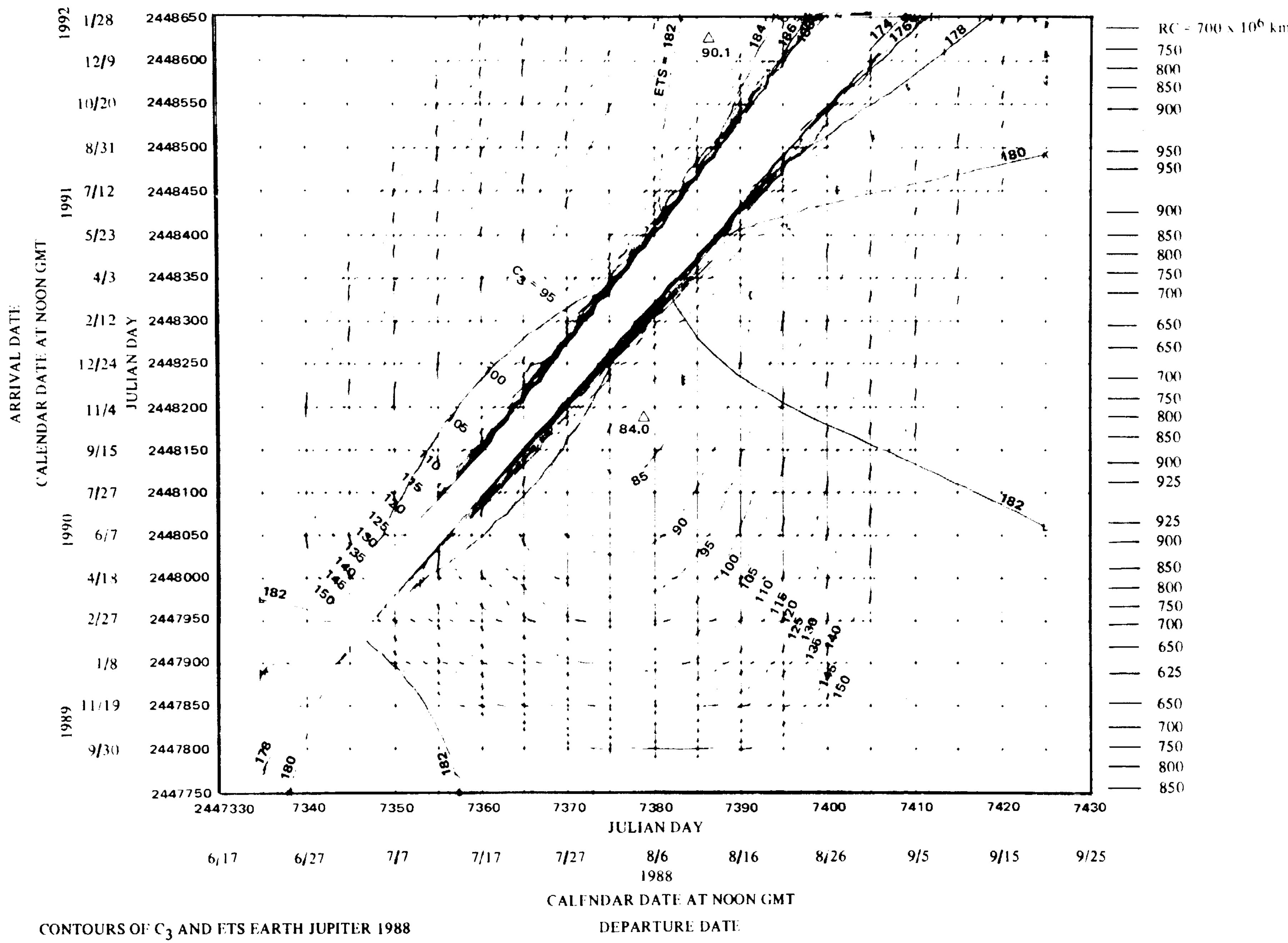

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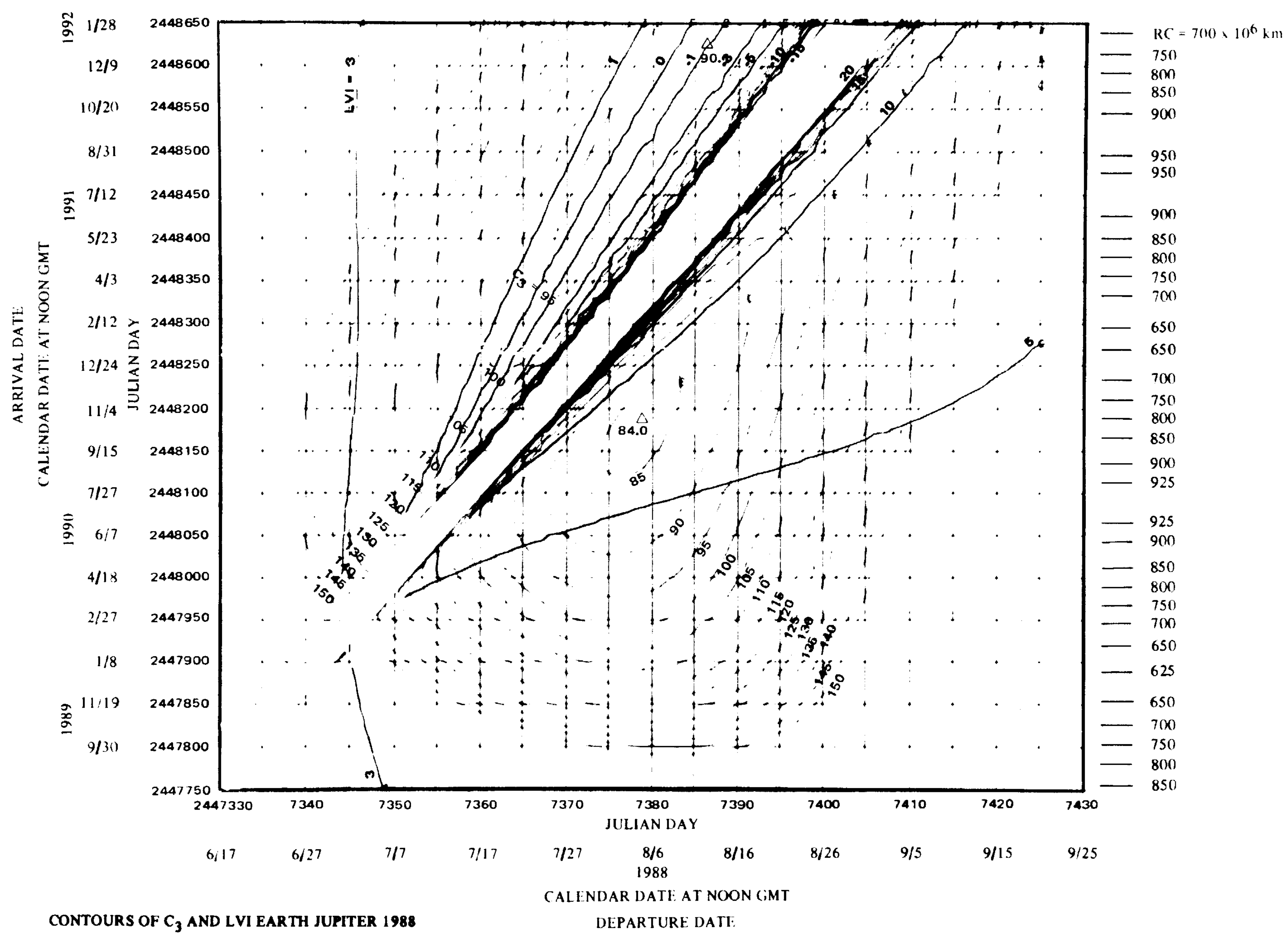

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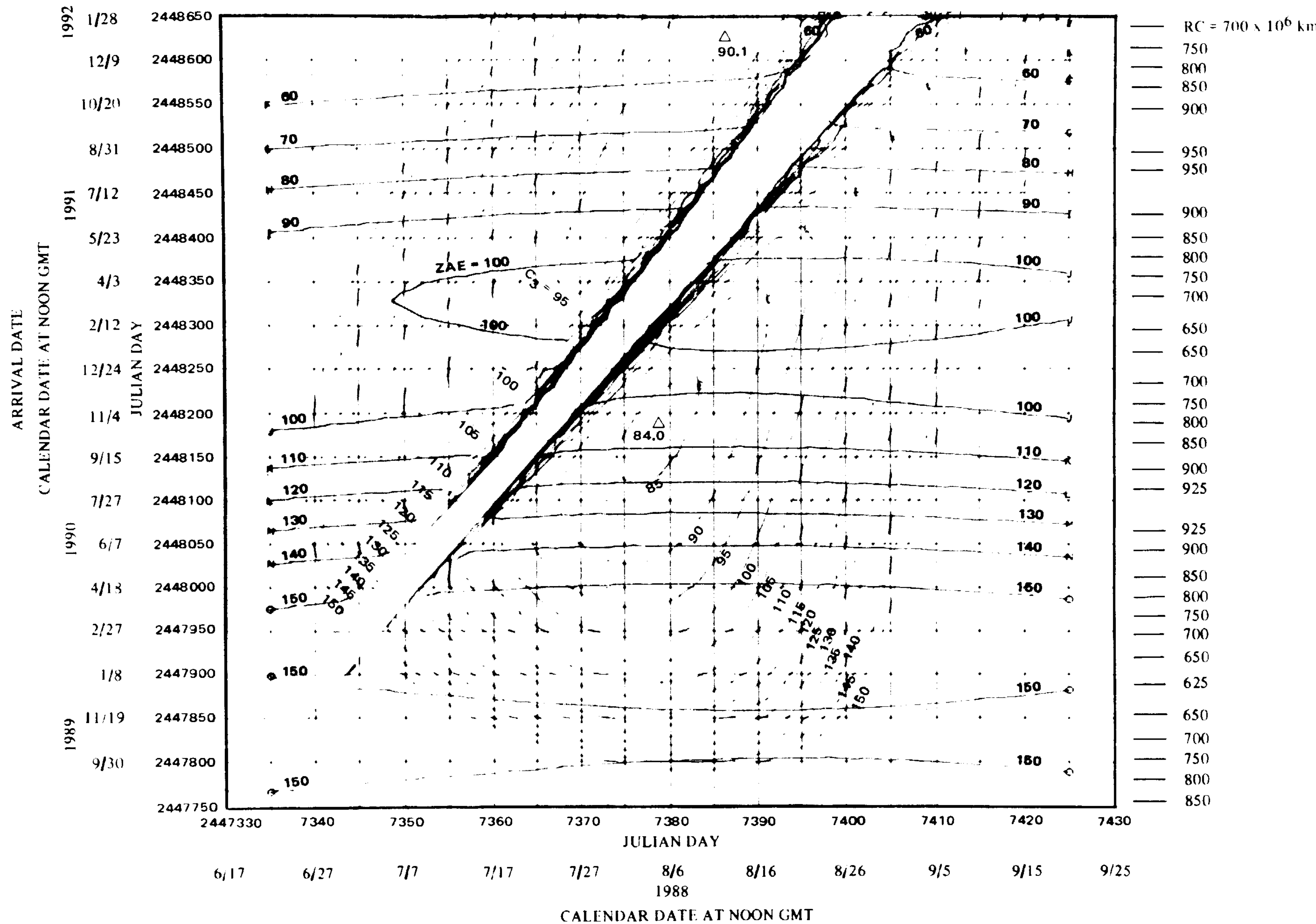

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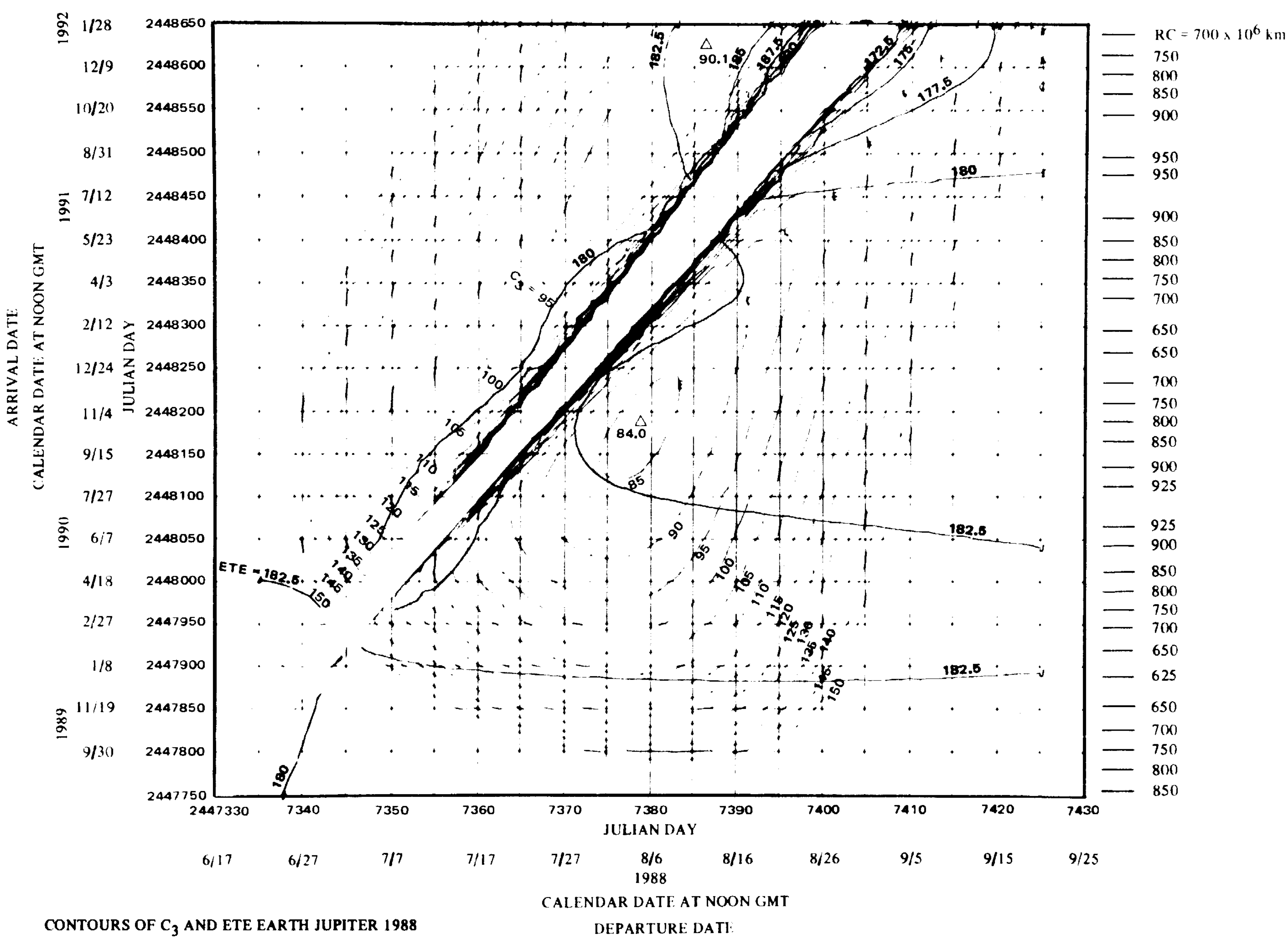

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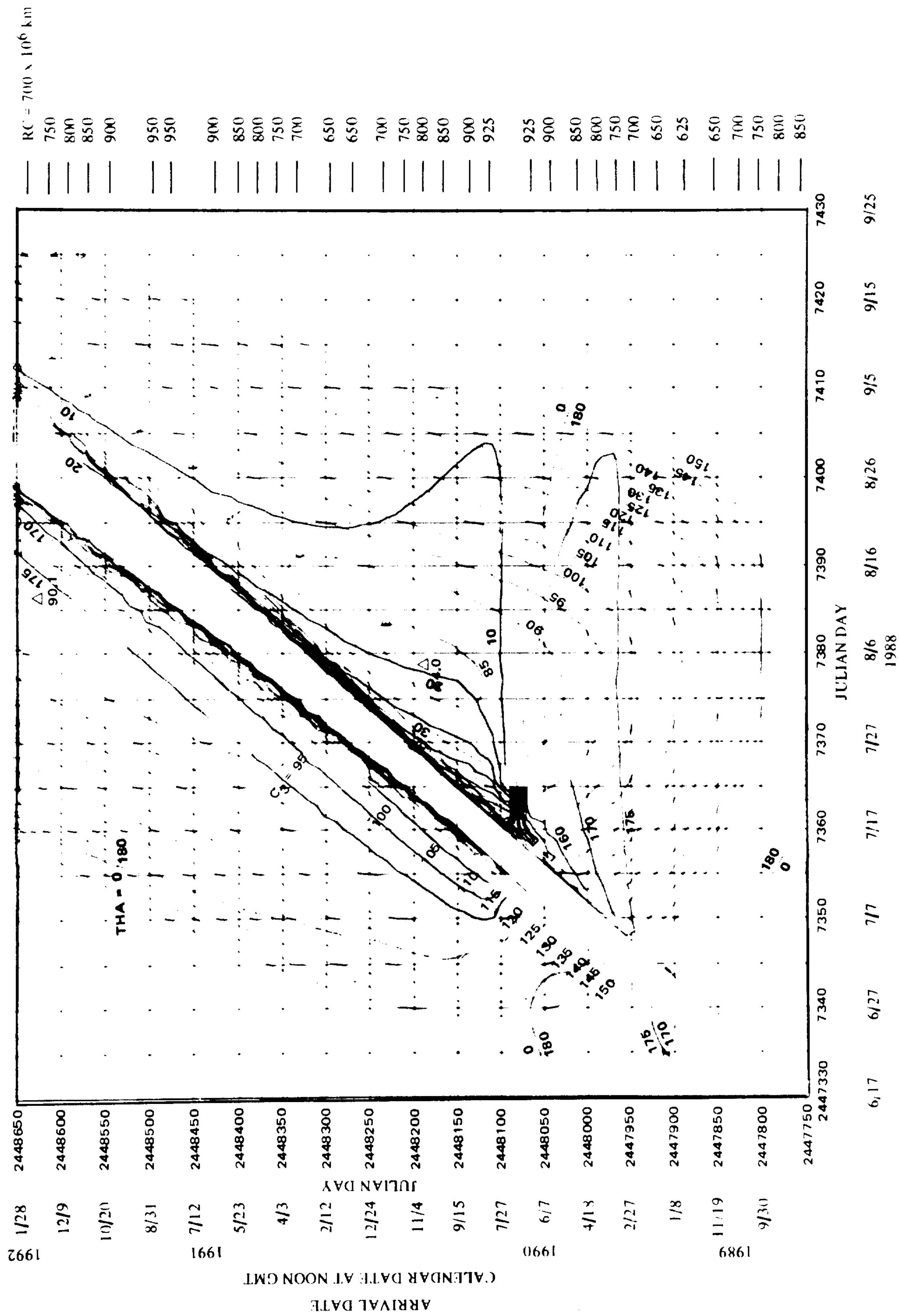

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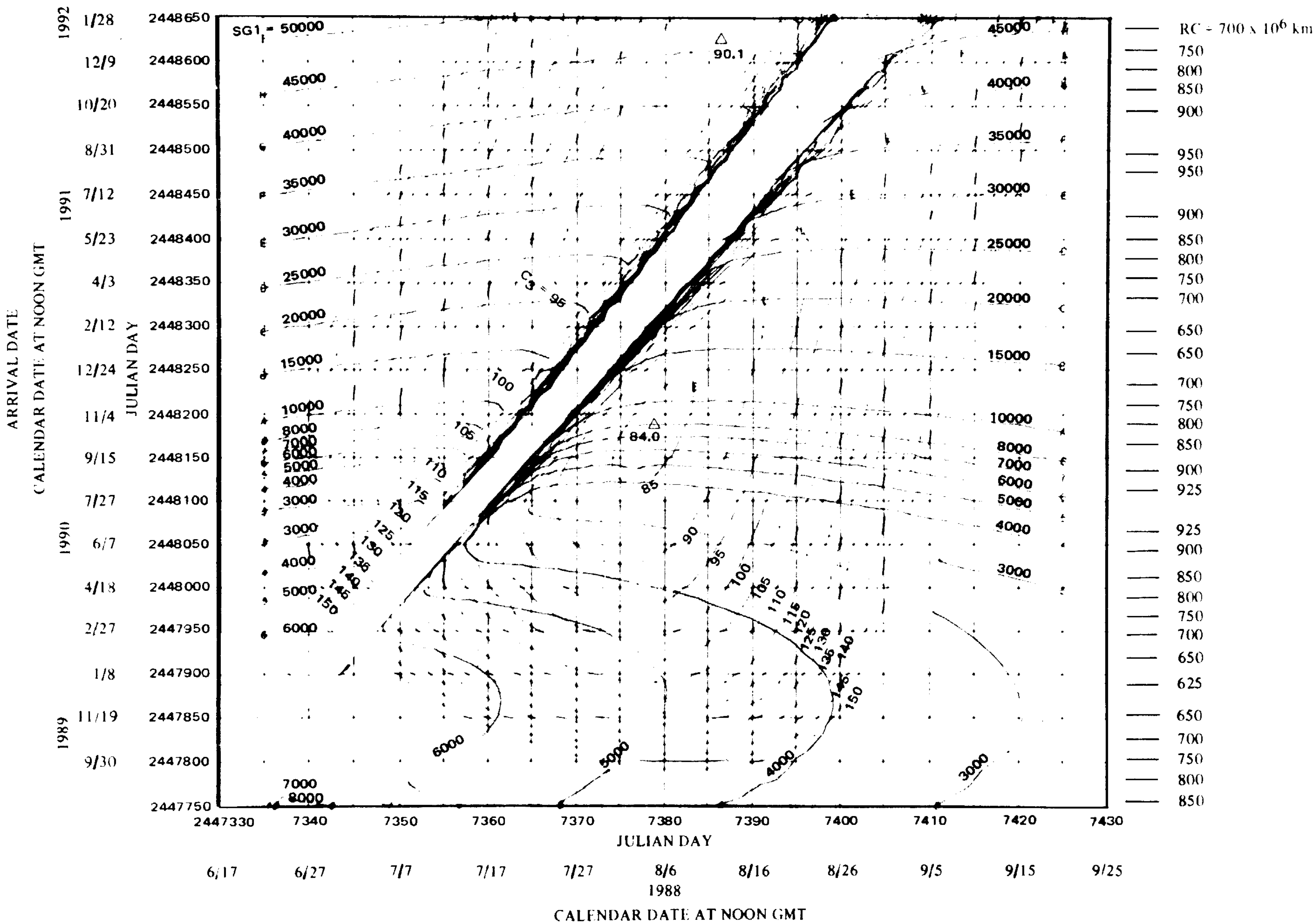
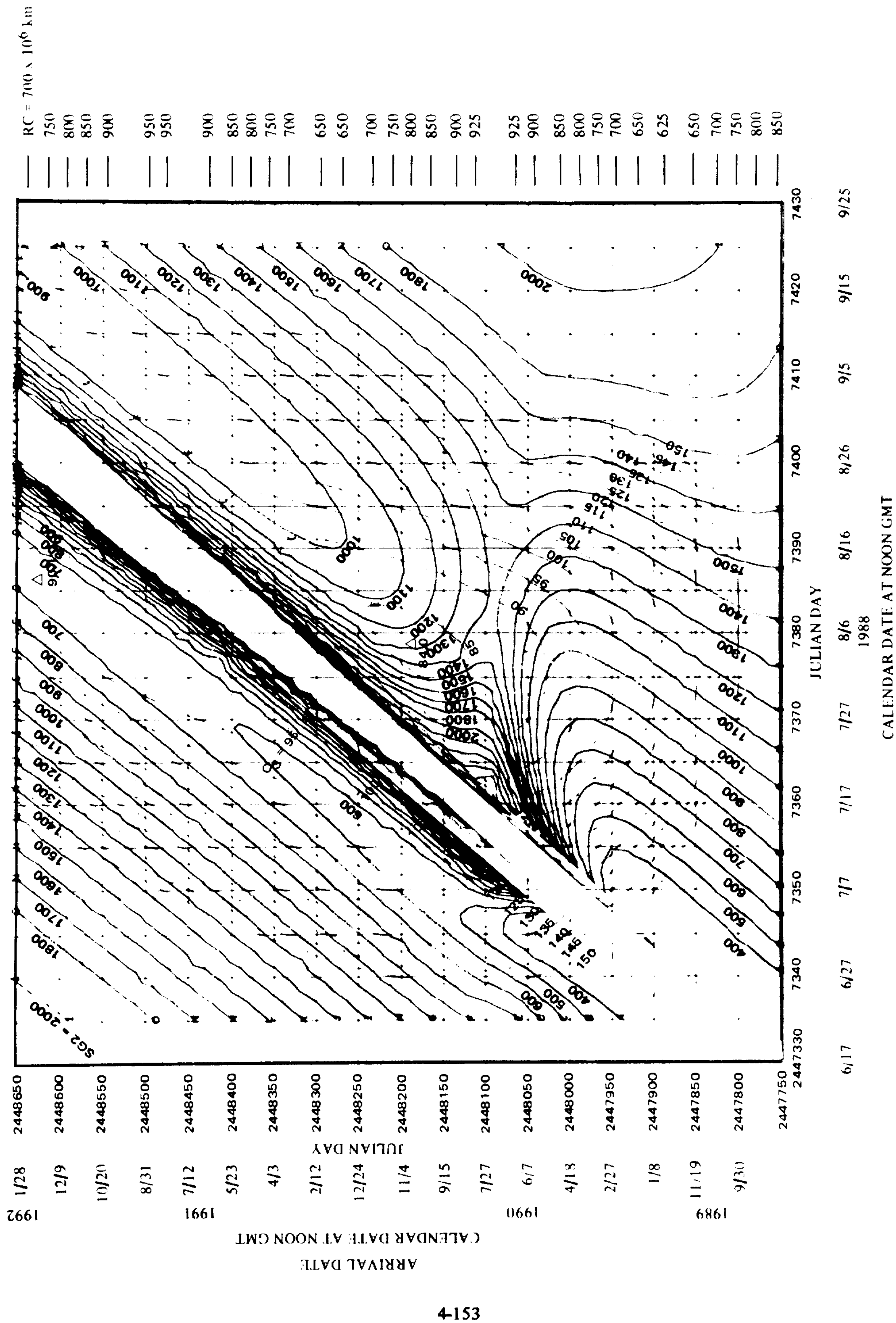


CONTOURS OF C_3 AND SG1 EARTH JUPITER 1988



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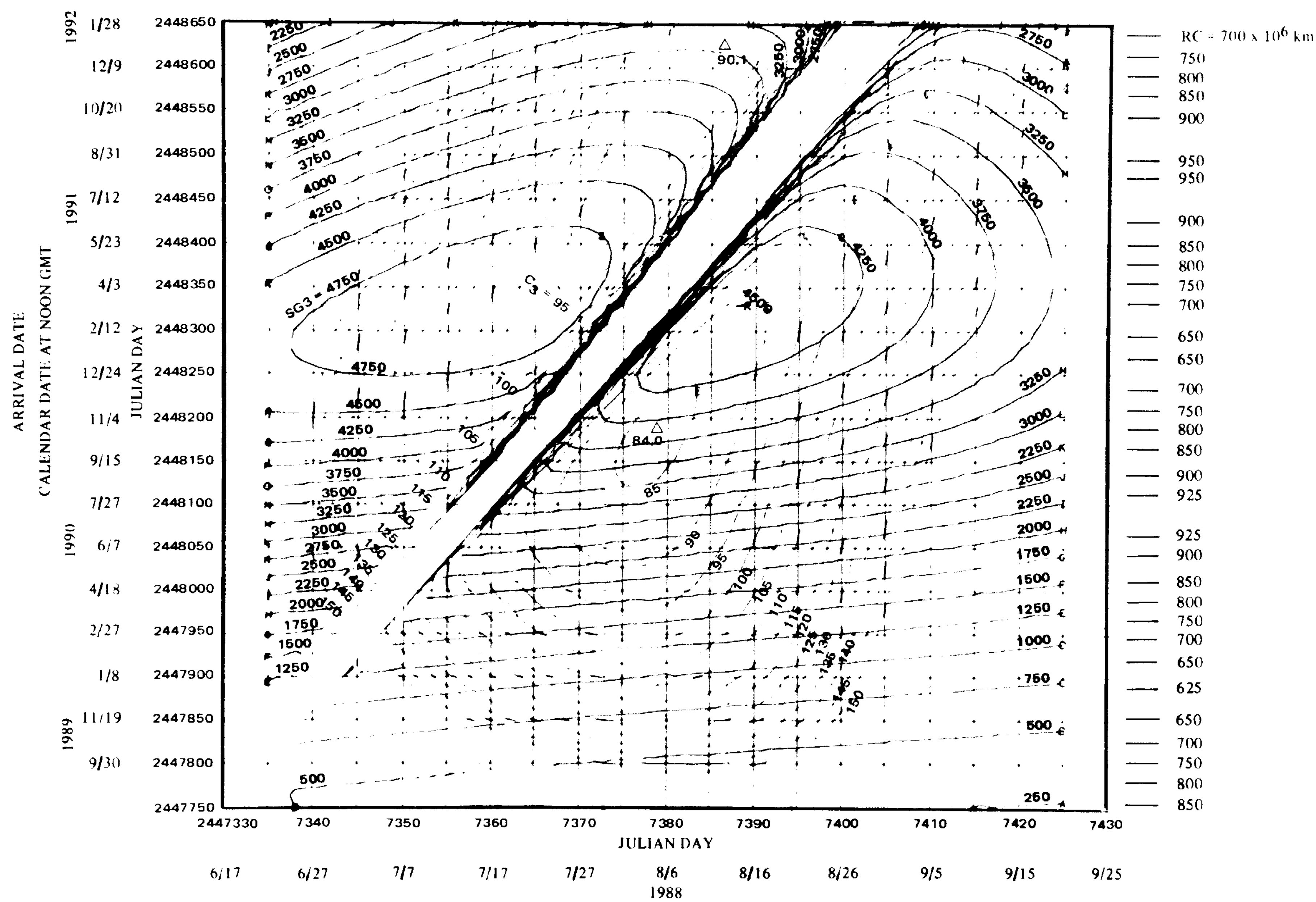

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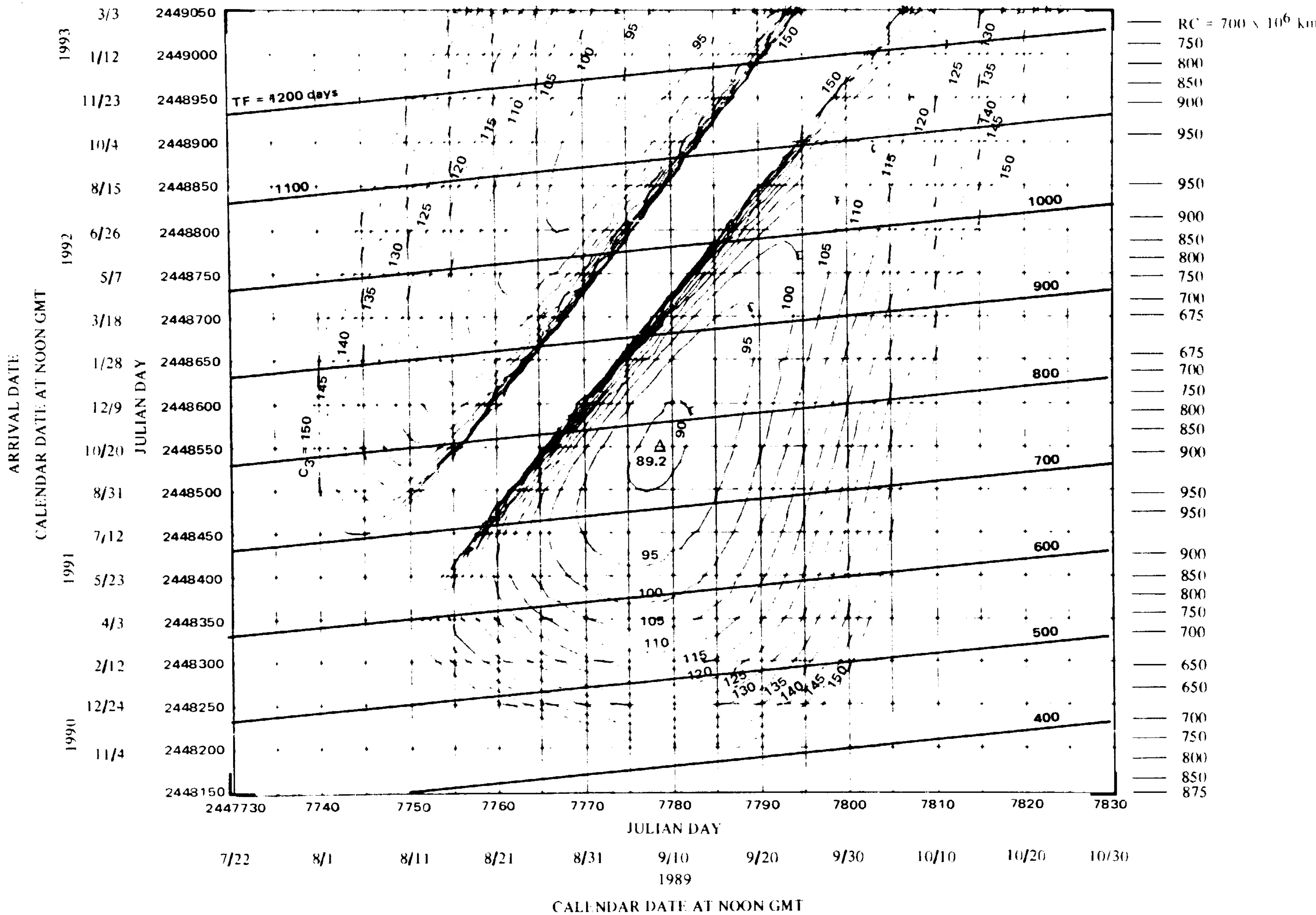
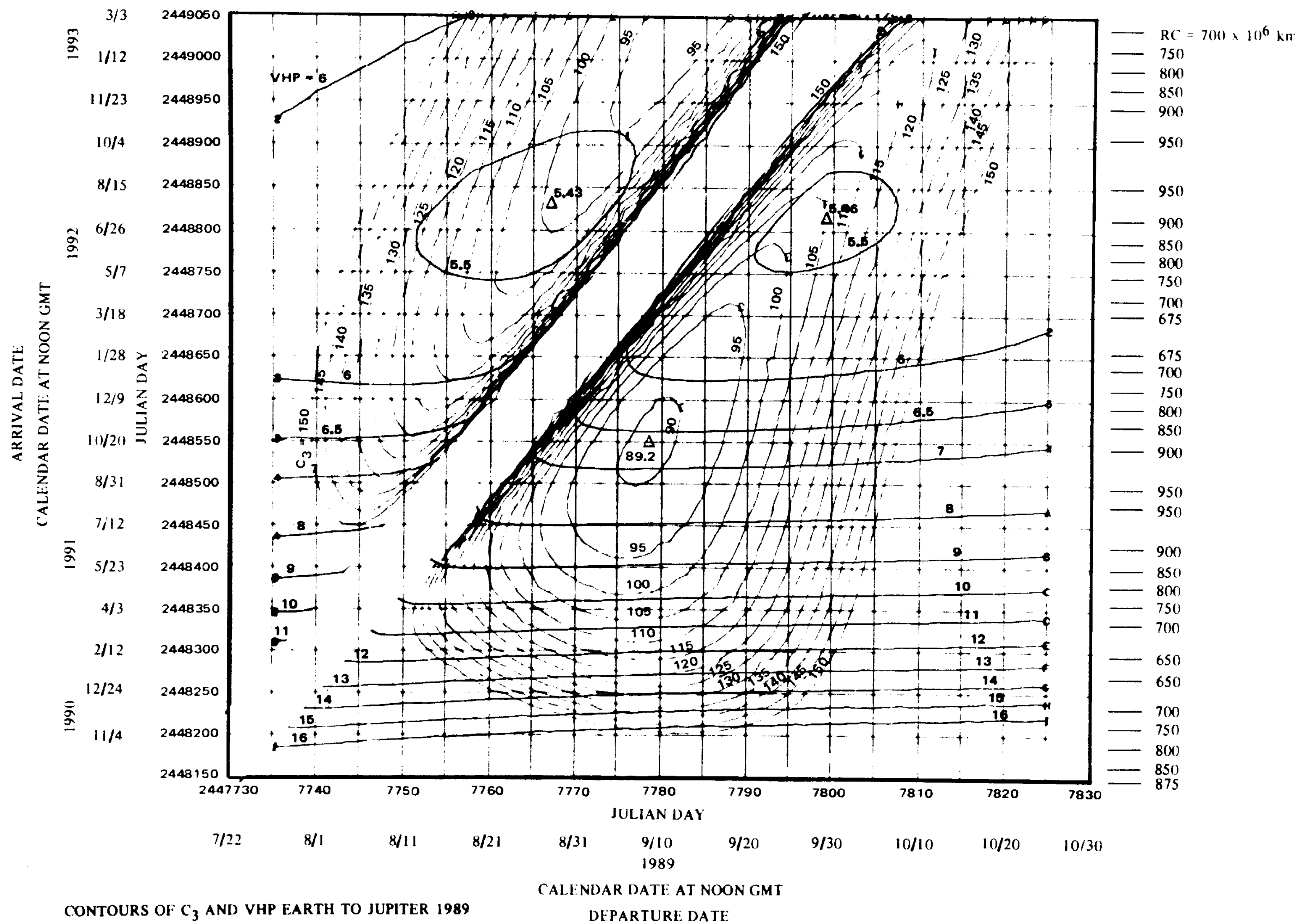


CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1989

DEPARTURE DATE



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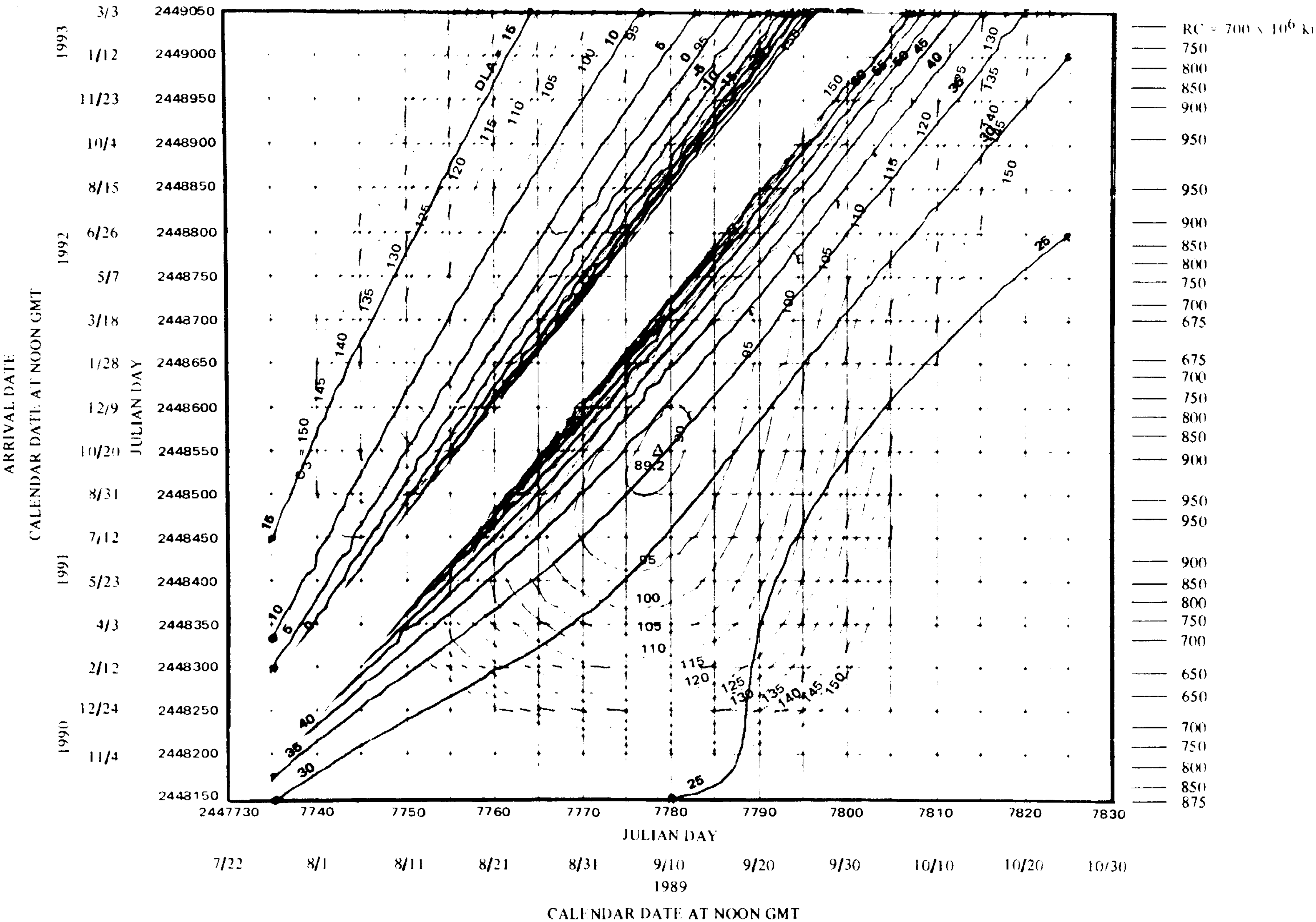

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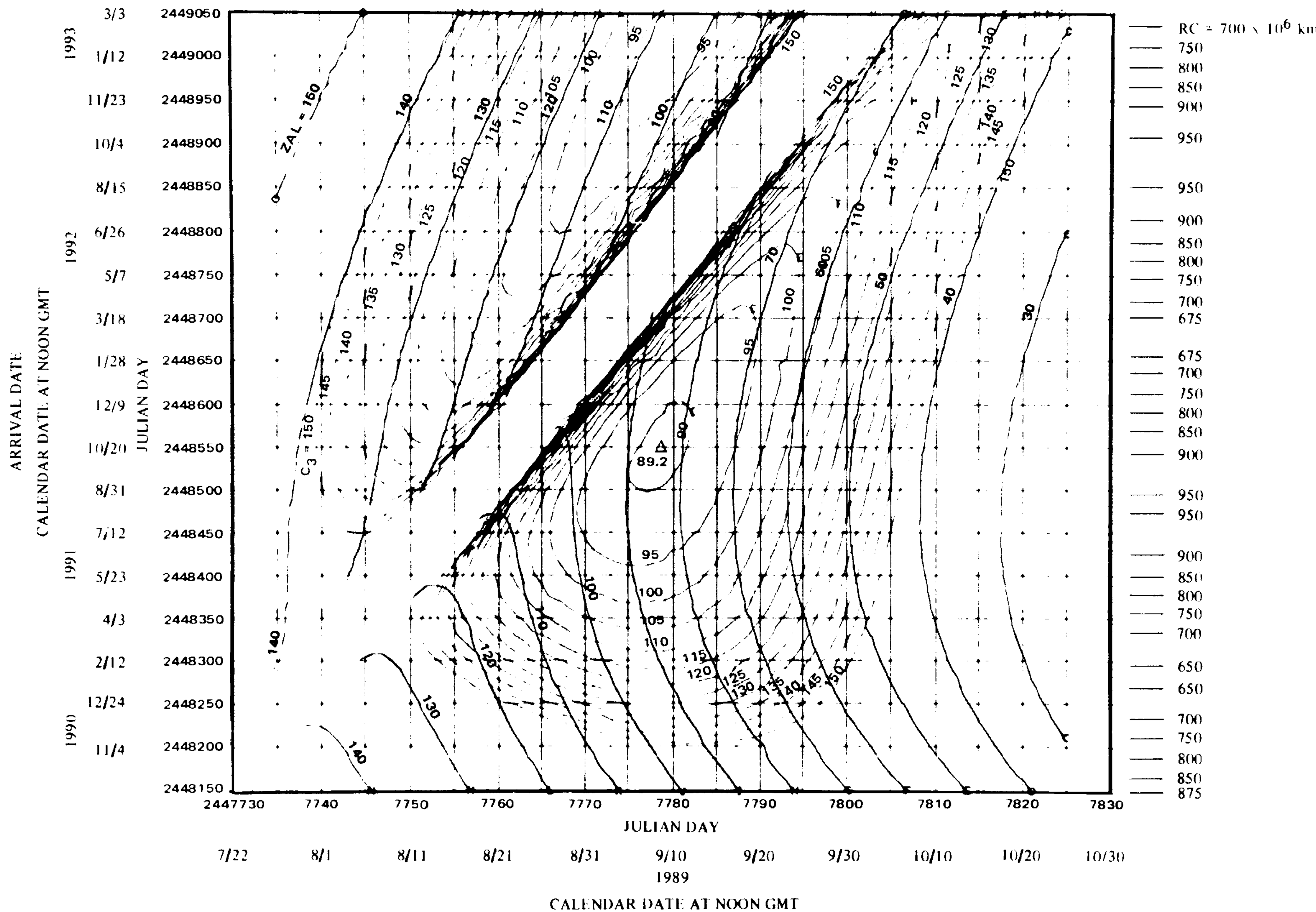

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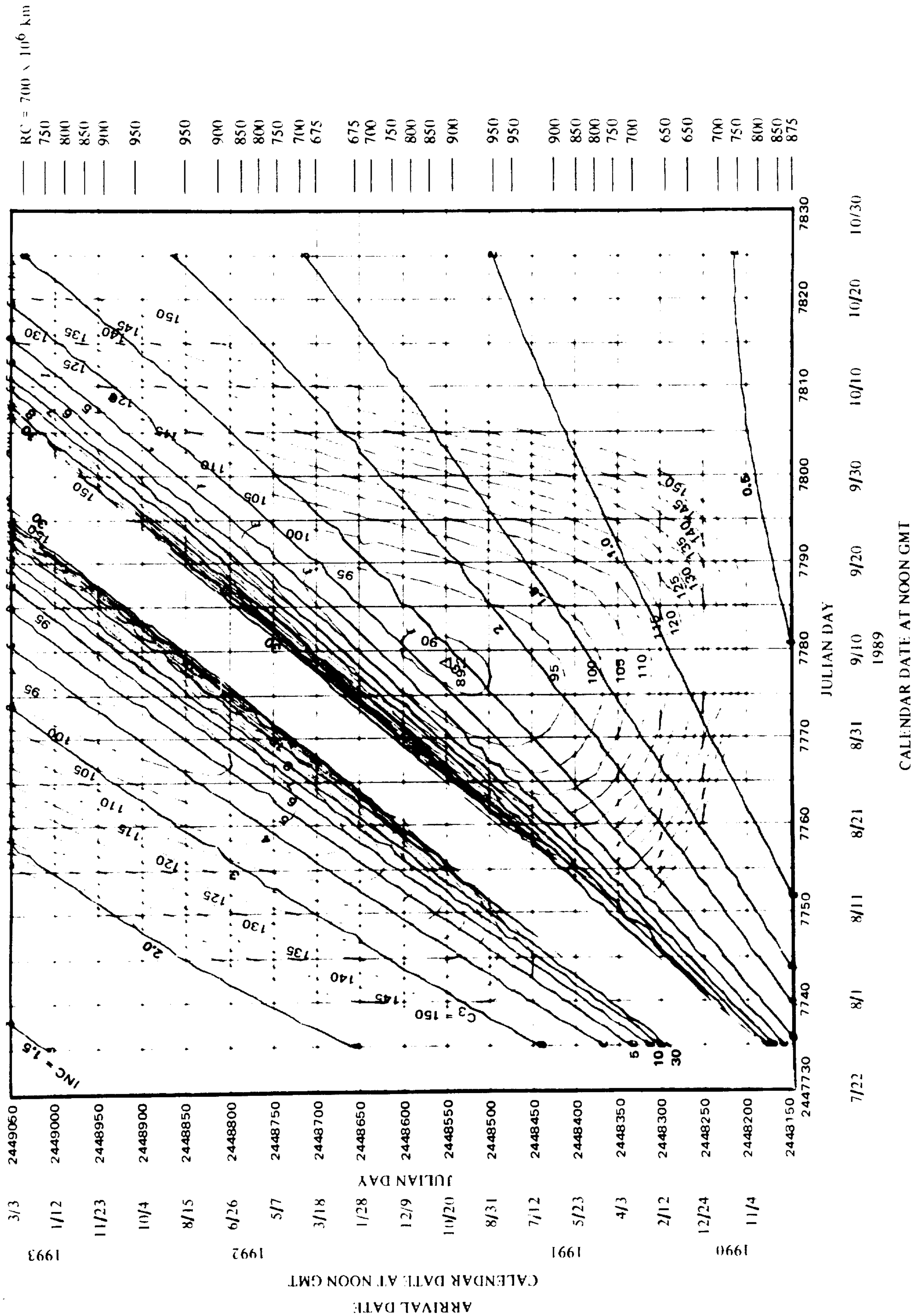

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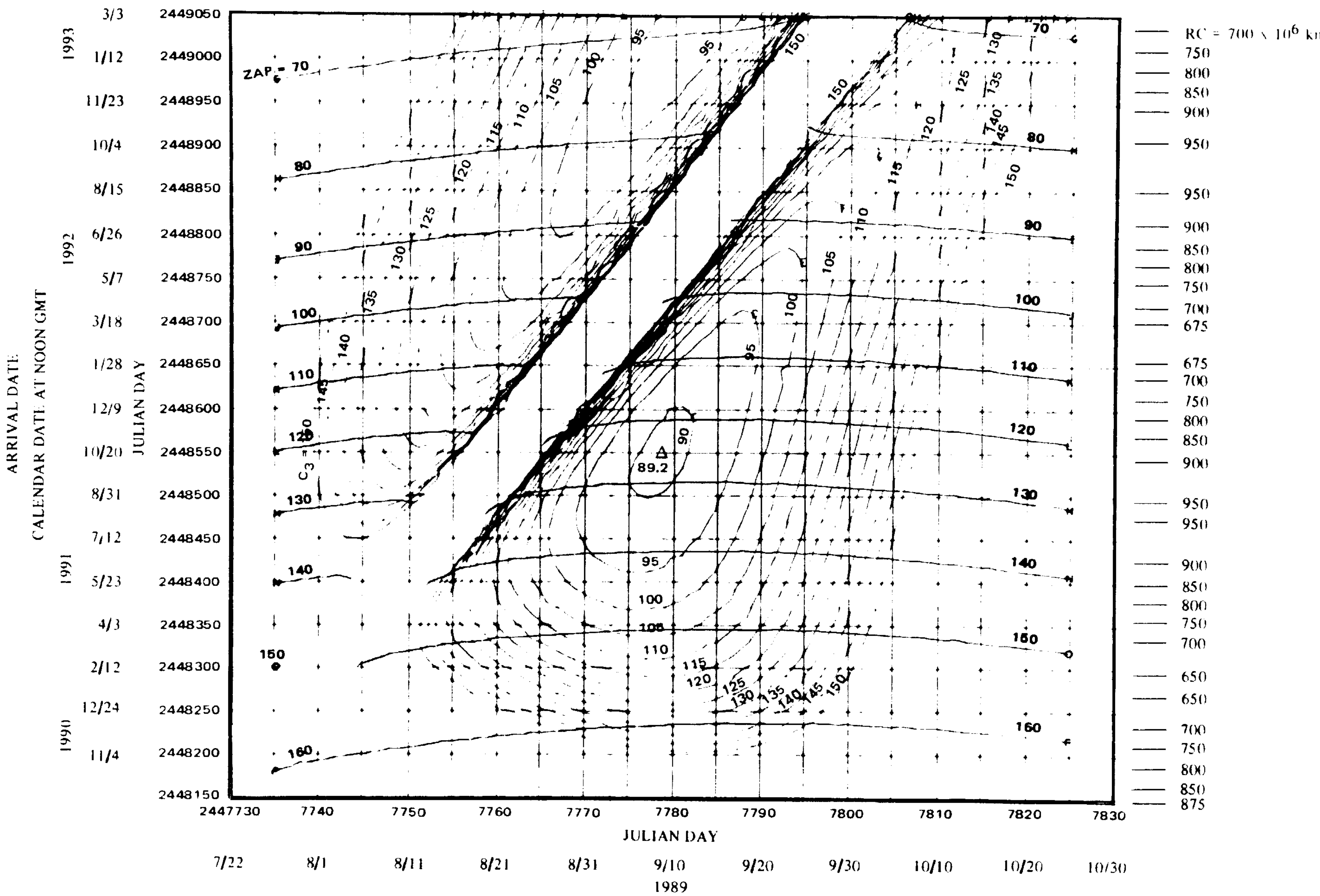

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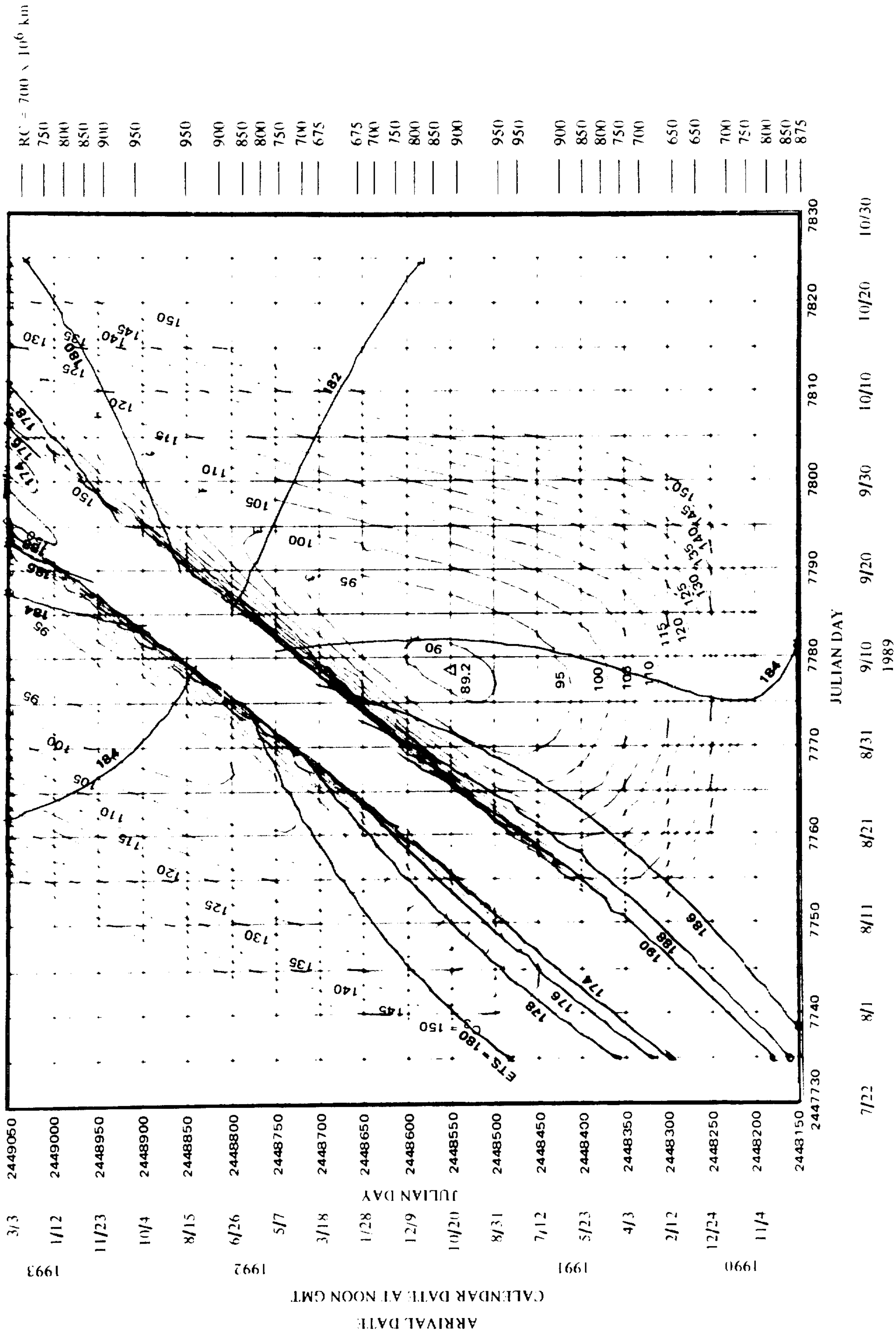
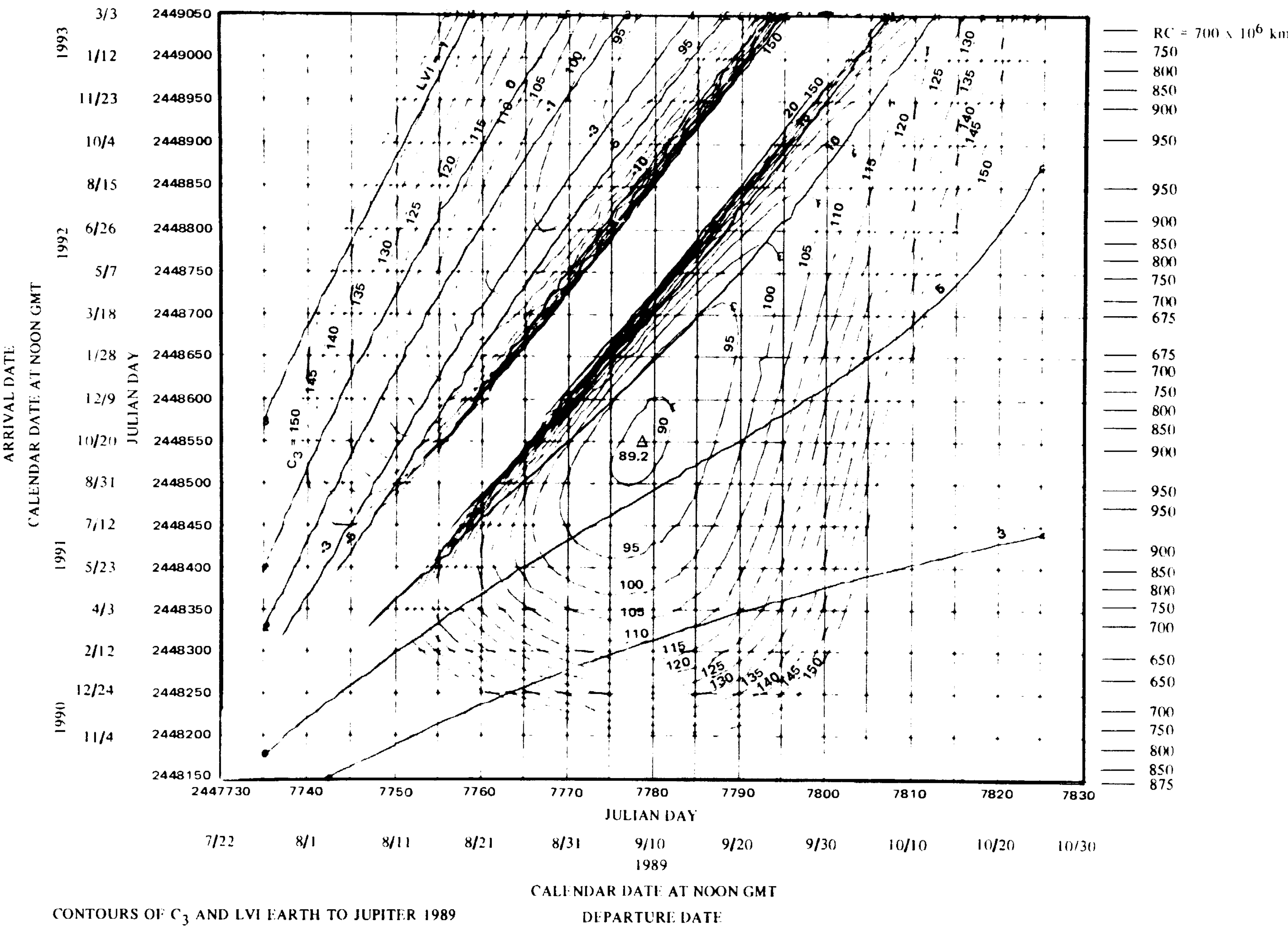


CONTOURS OF C_3 AND ETS EARTH TO JUPITER 1989



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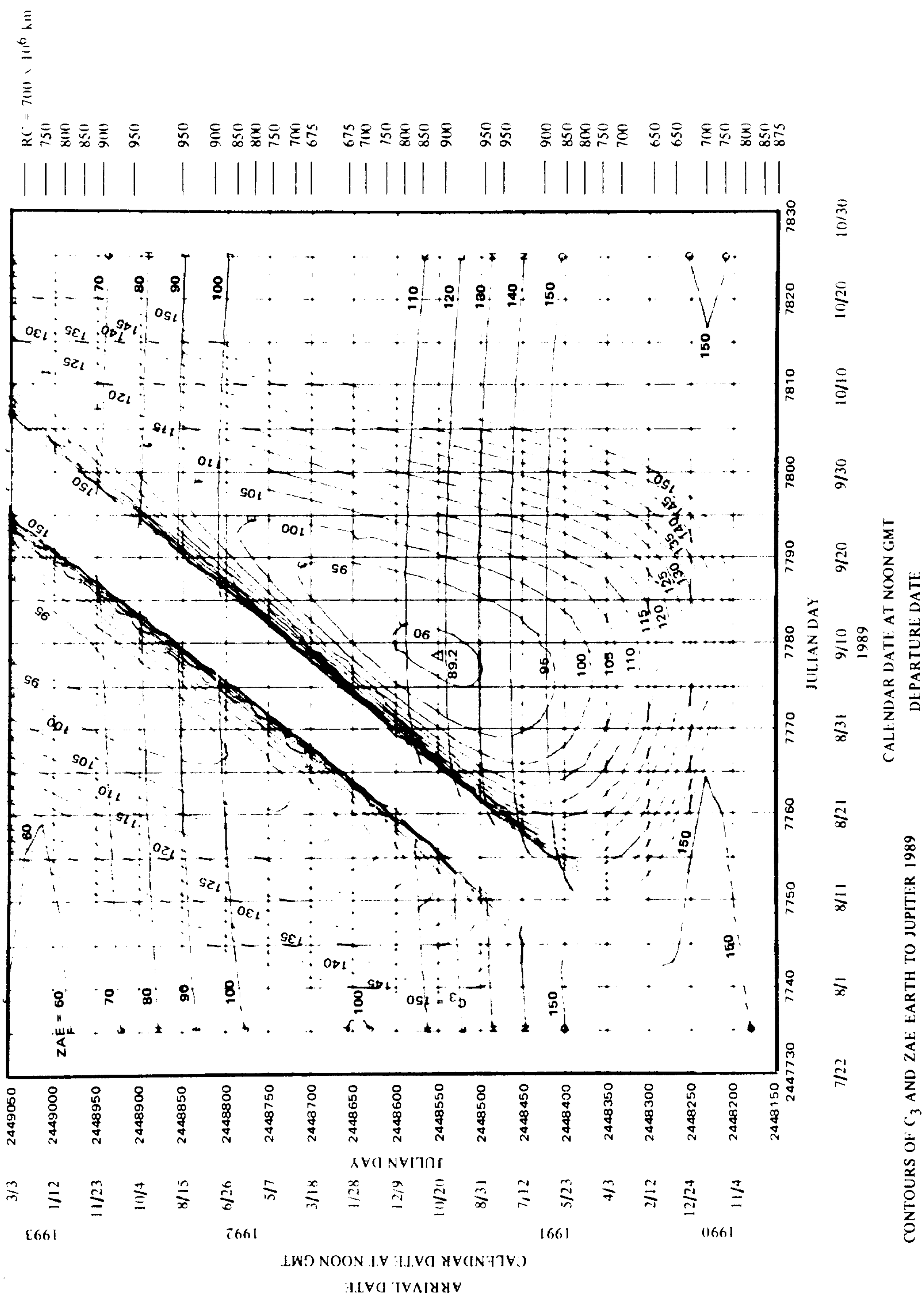

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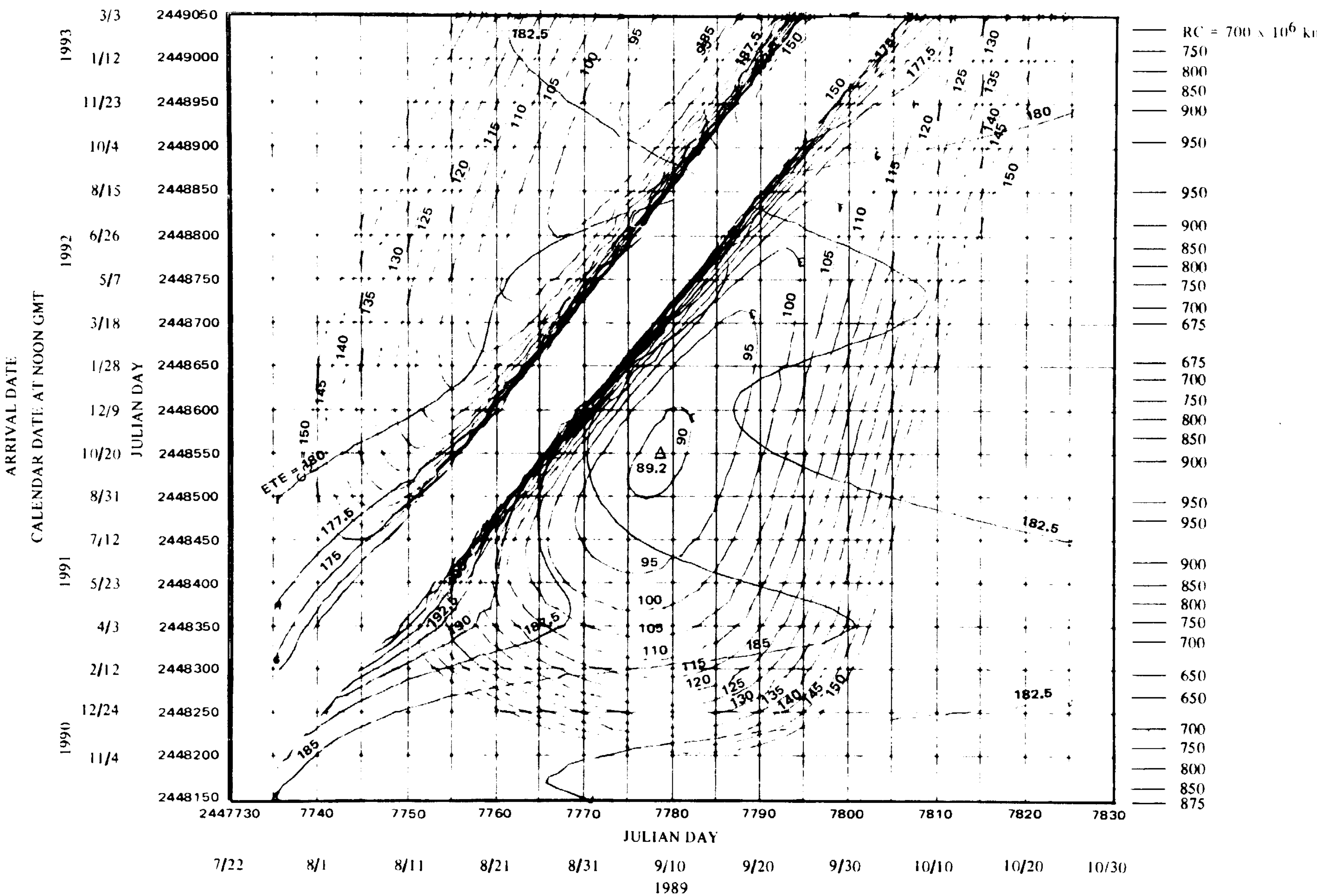

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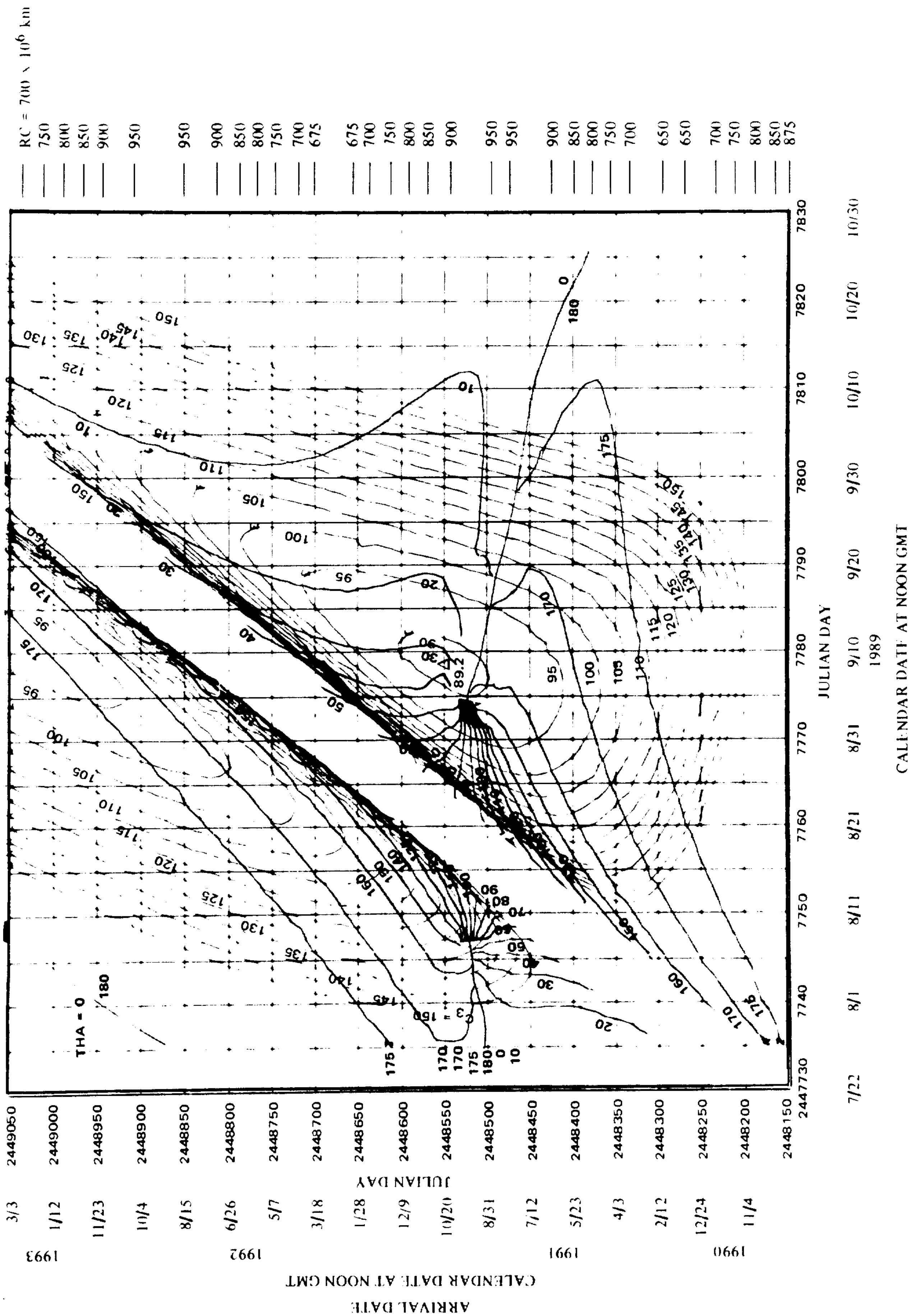
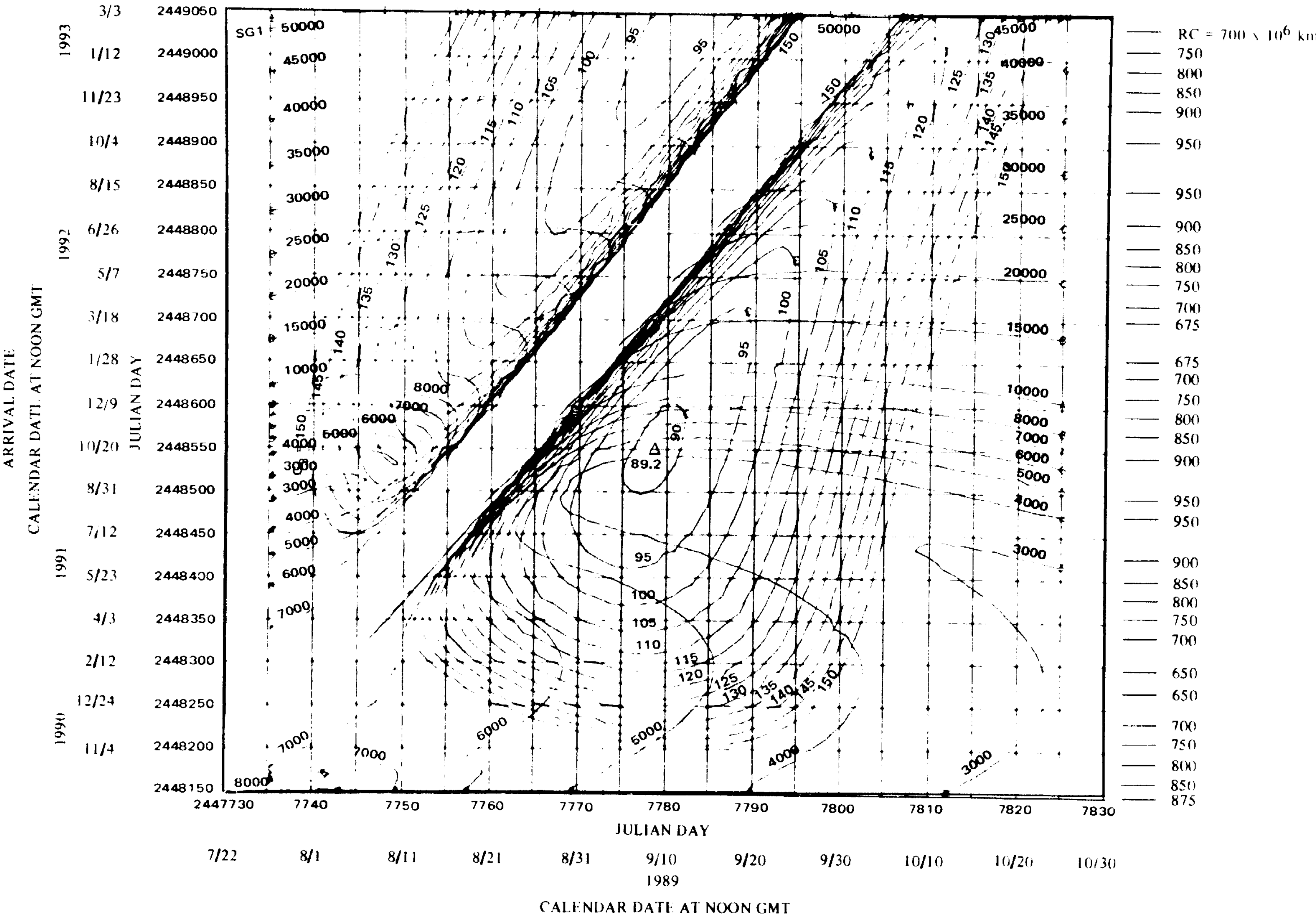


CONTOURS OF C_3 AND THA EARTH TO JUPITER 1989



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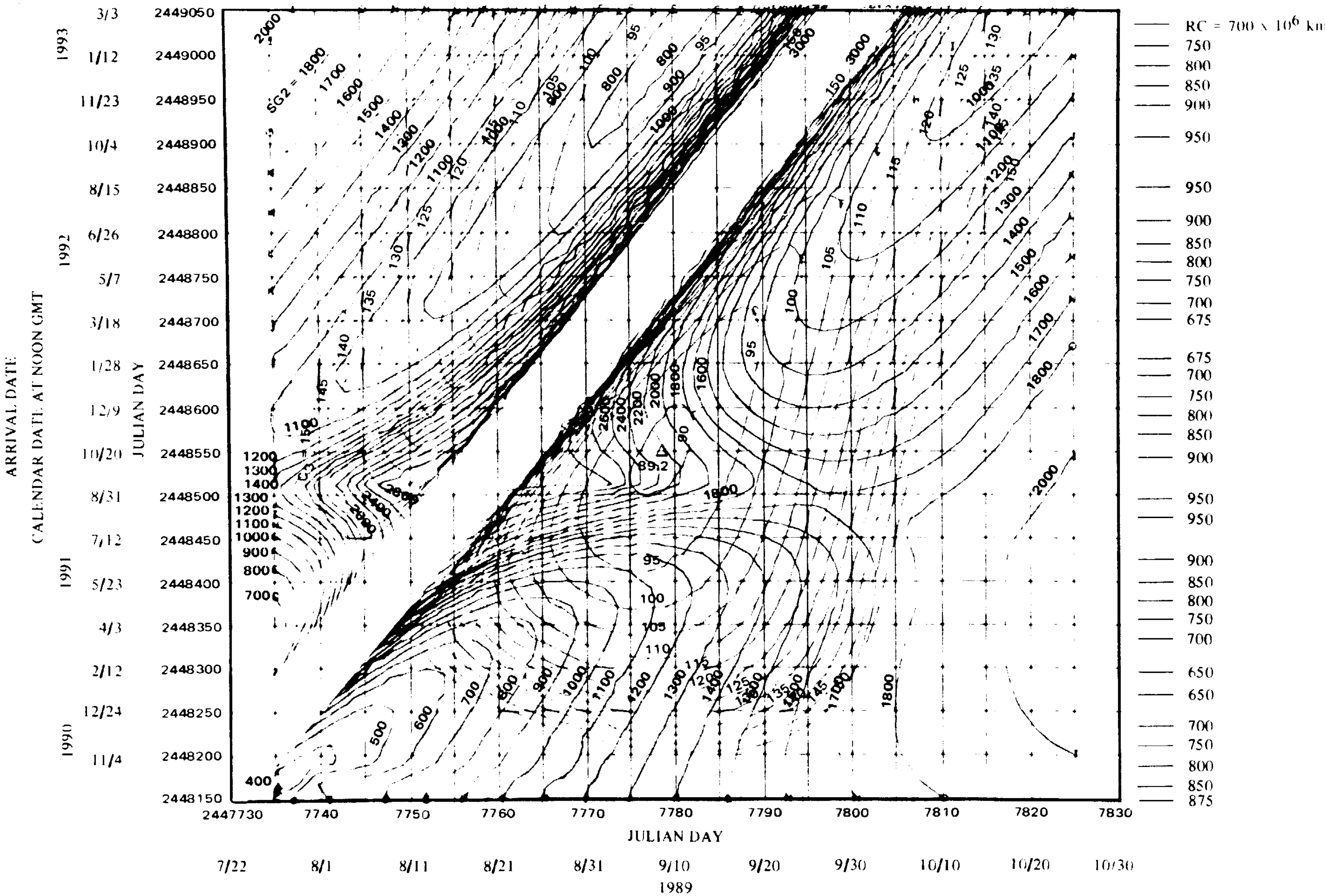

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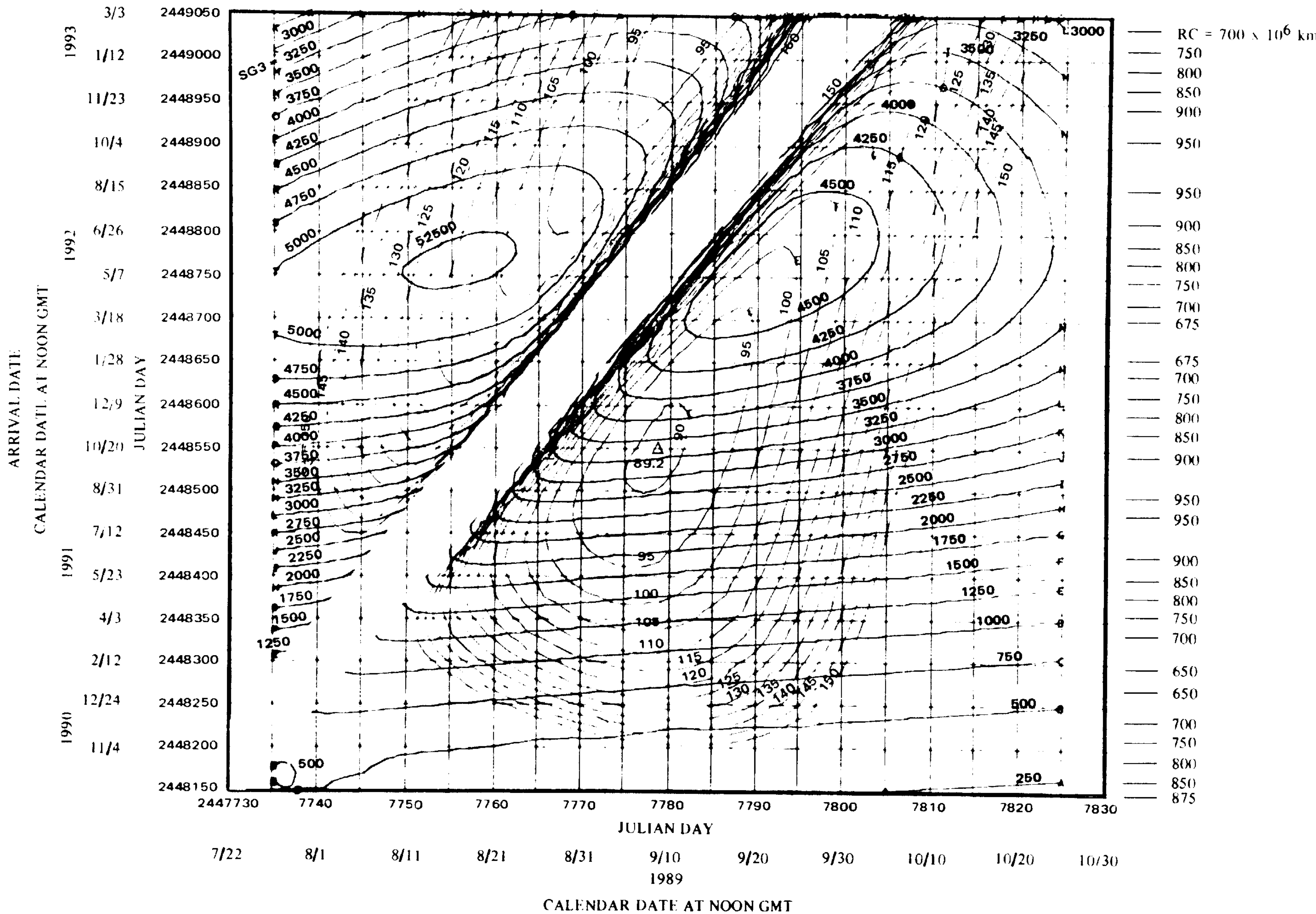
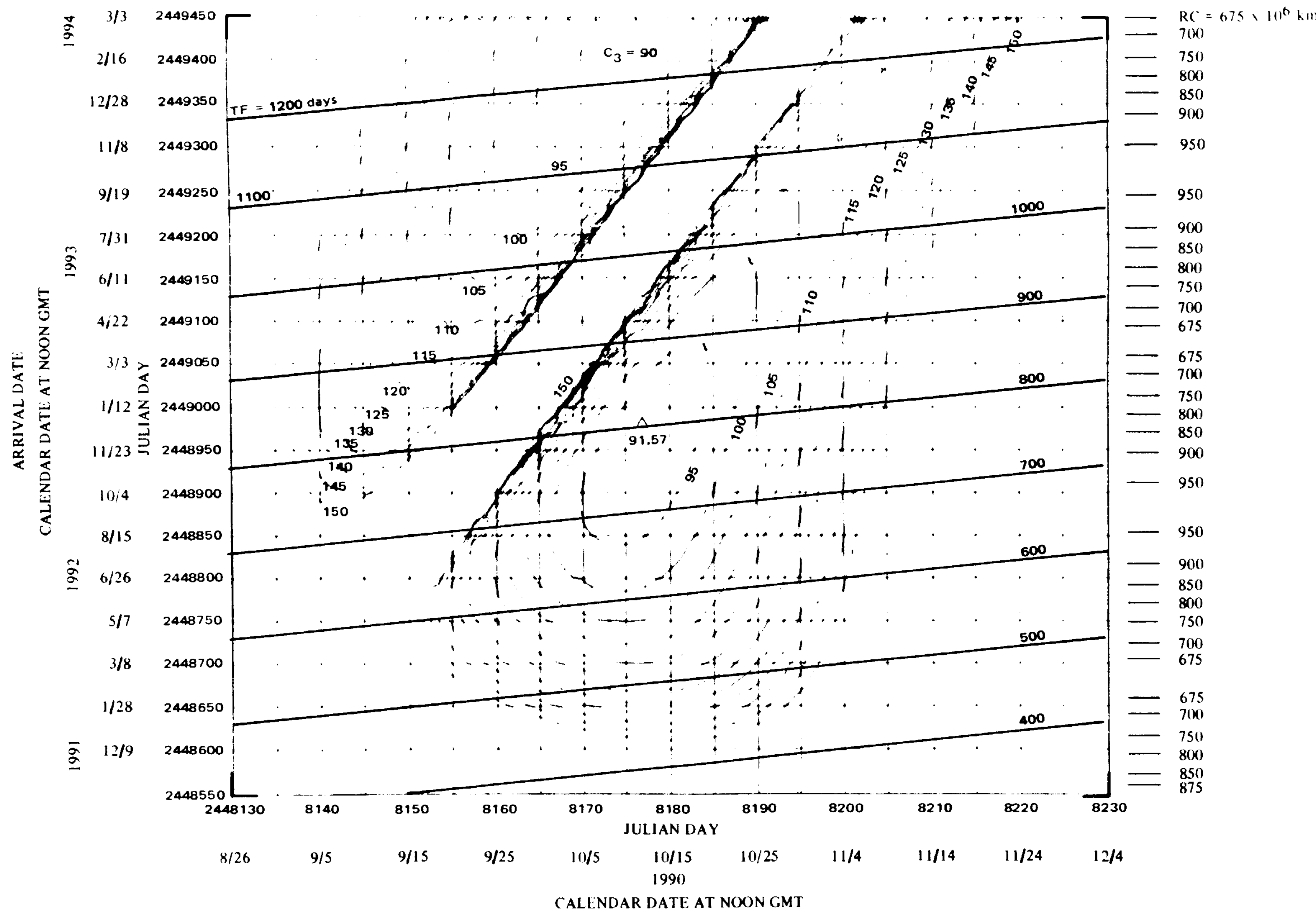
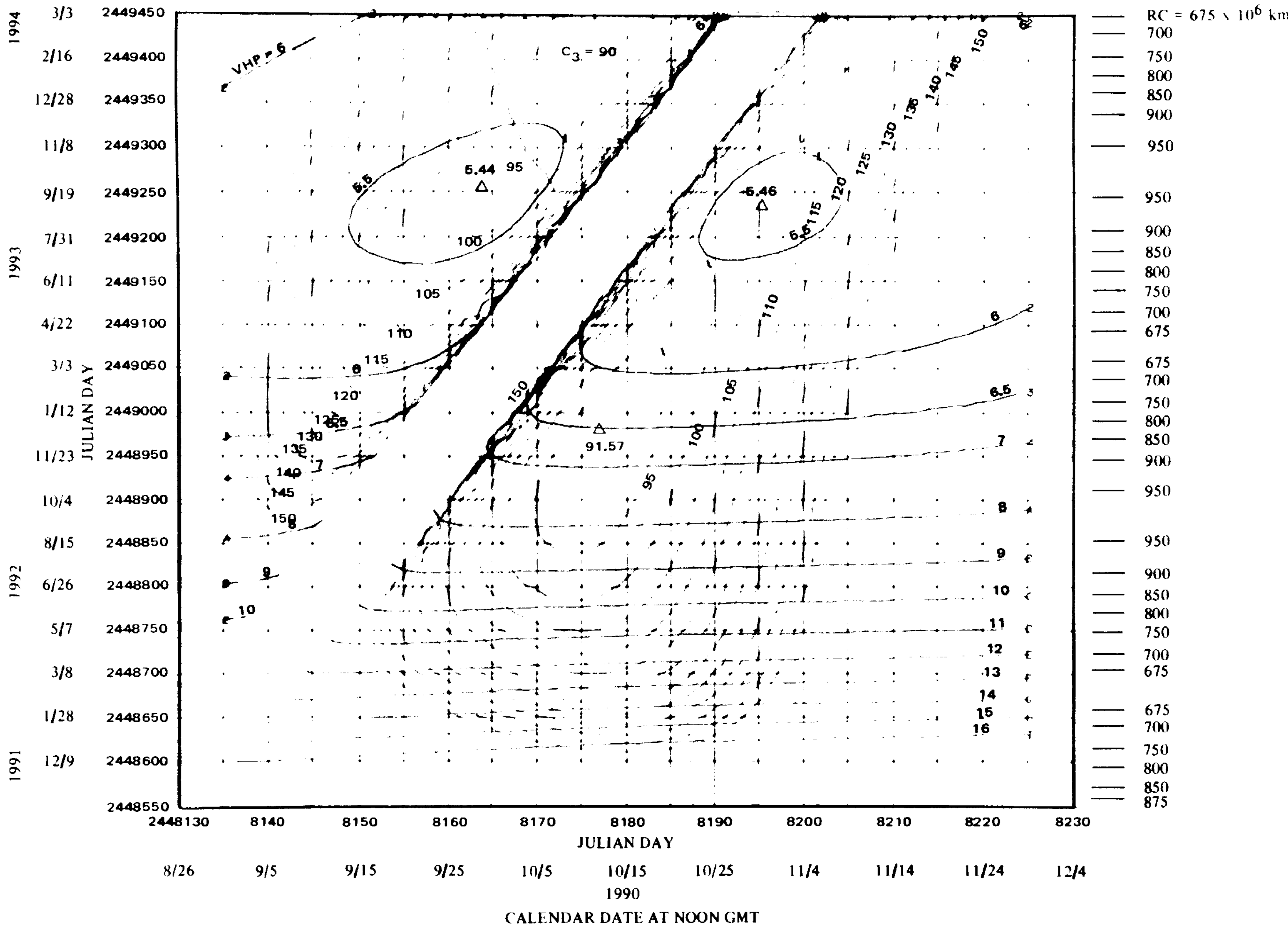


DEPARTURE DATE

CONTOURS OF C_3 AND SG3 EARTH TO JUPITER 1989



CONTOURS OF C_3 AND FLIGHT TIMES EARTH TO JUPITER 1990



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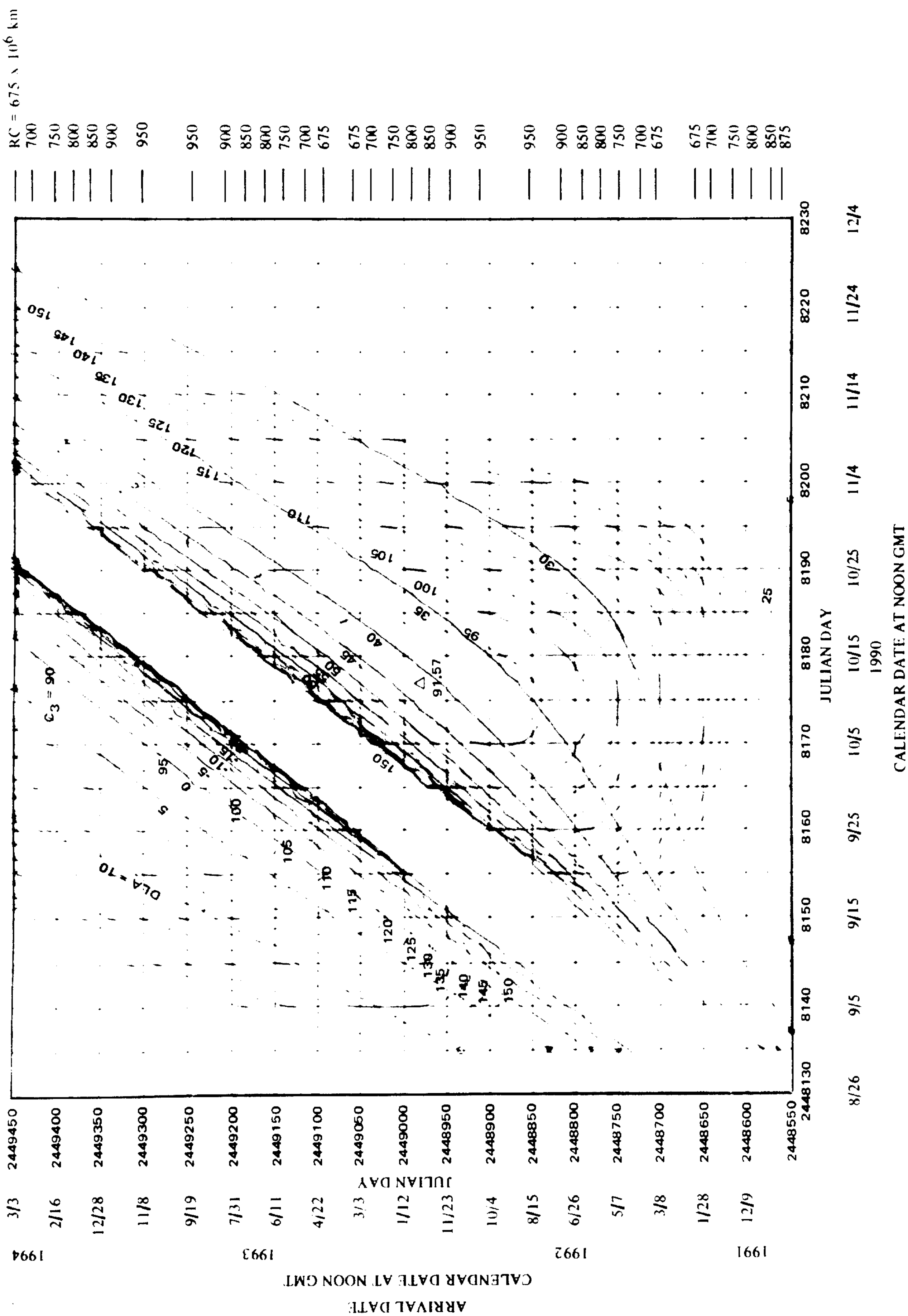

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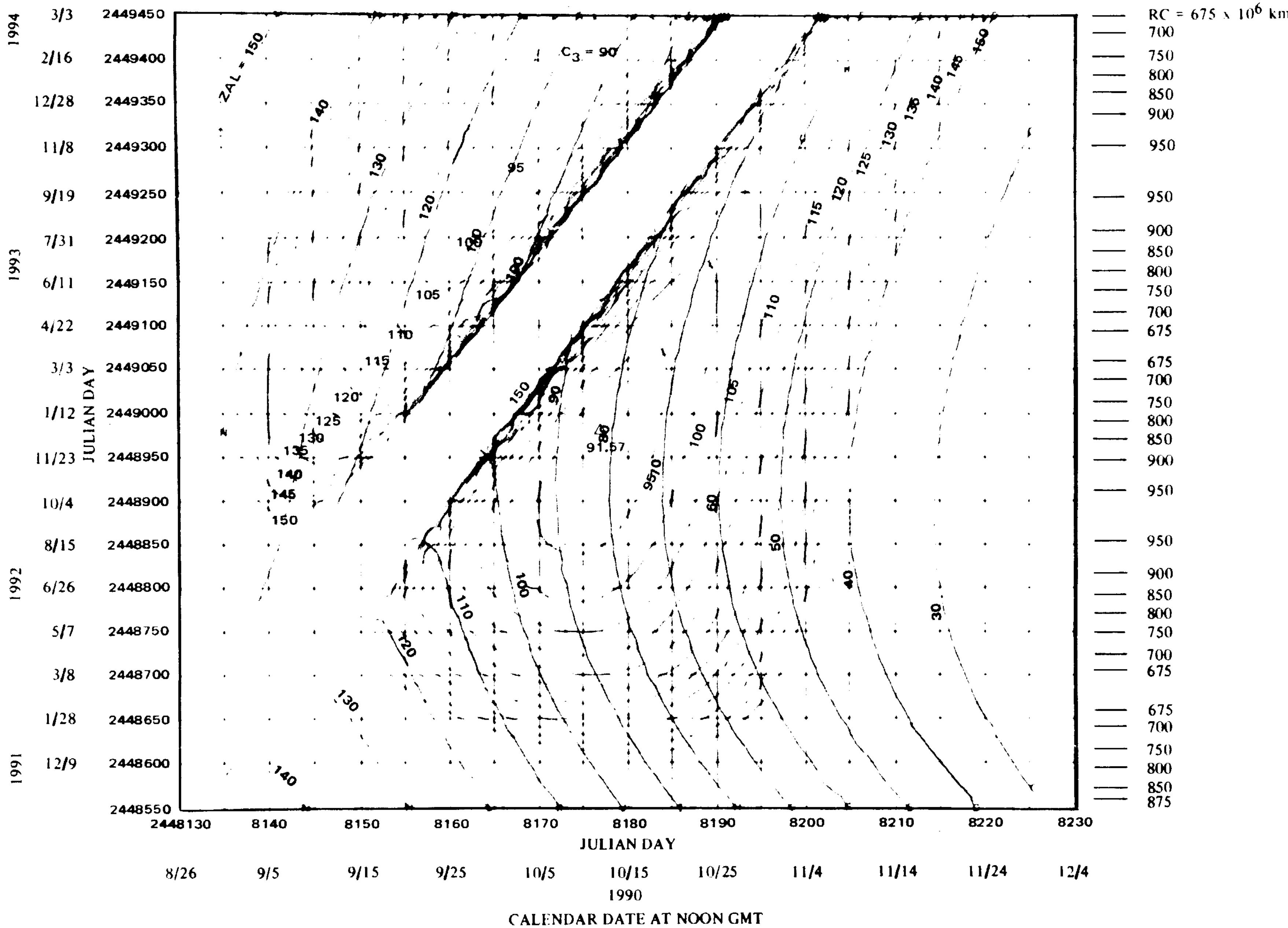

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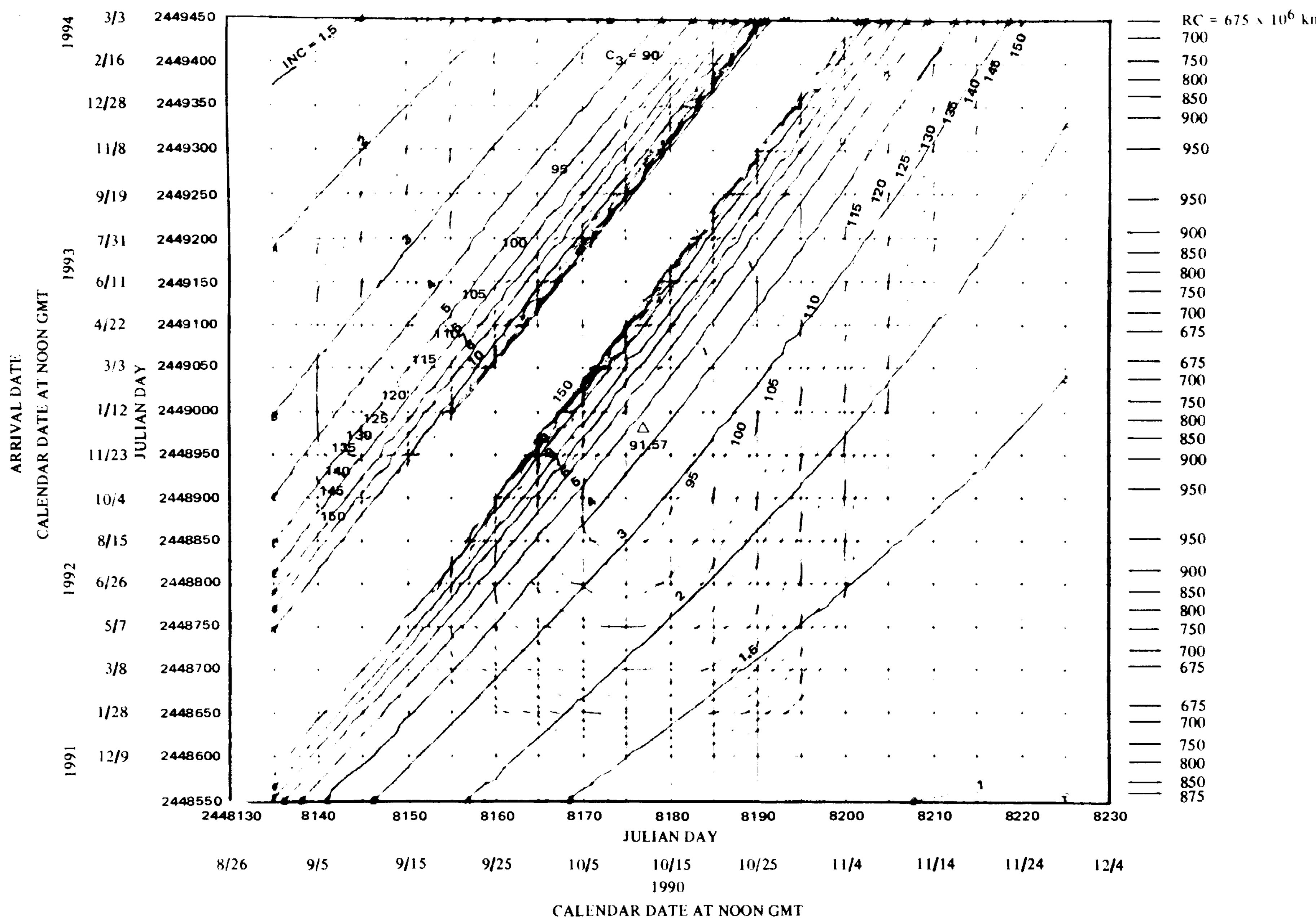

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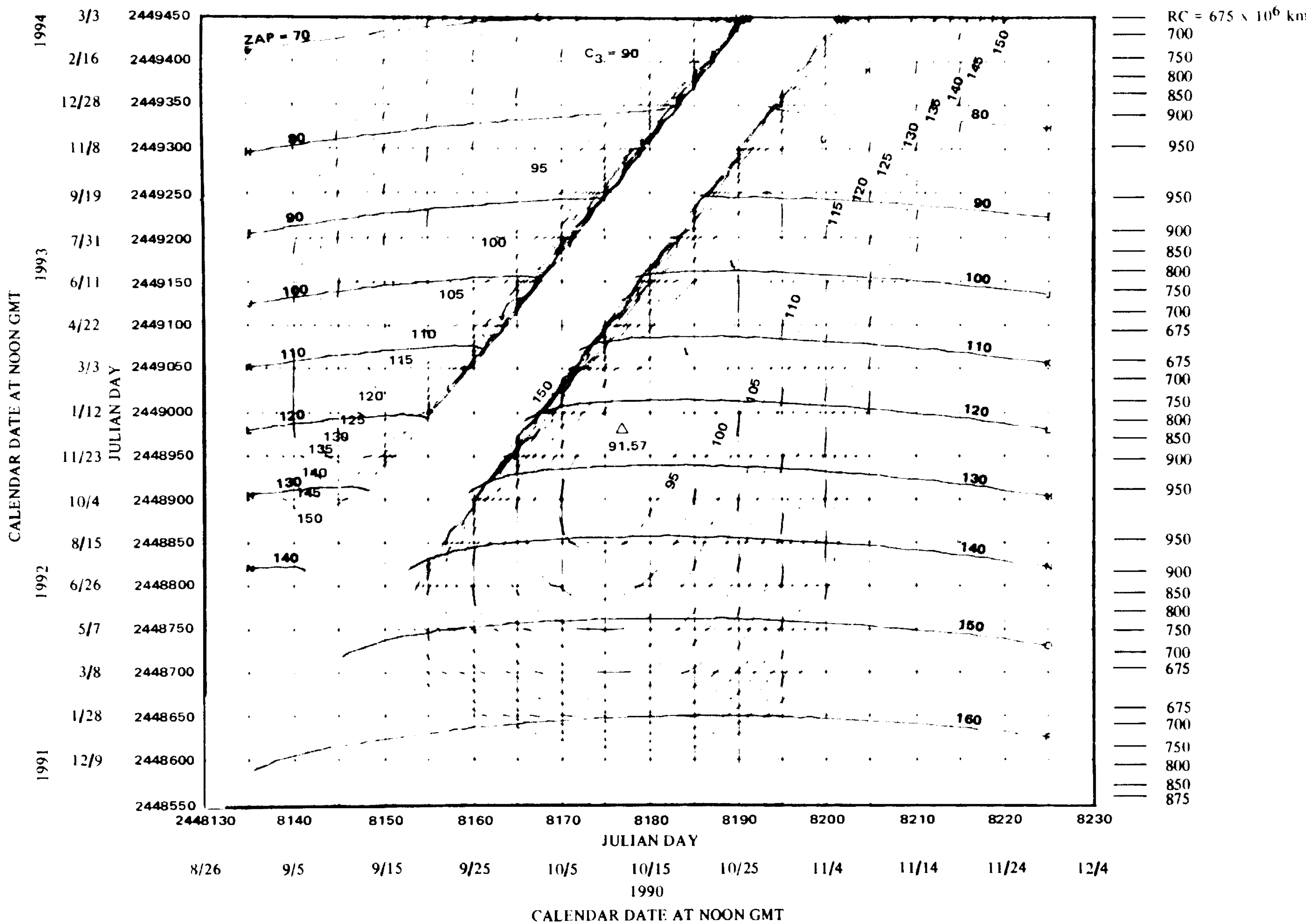

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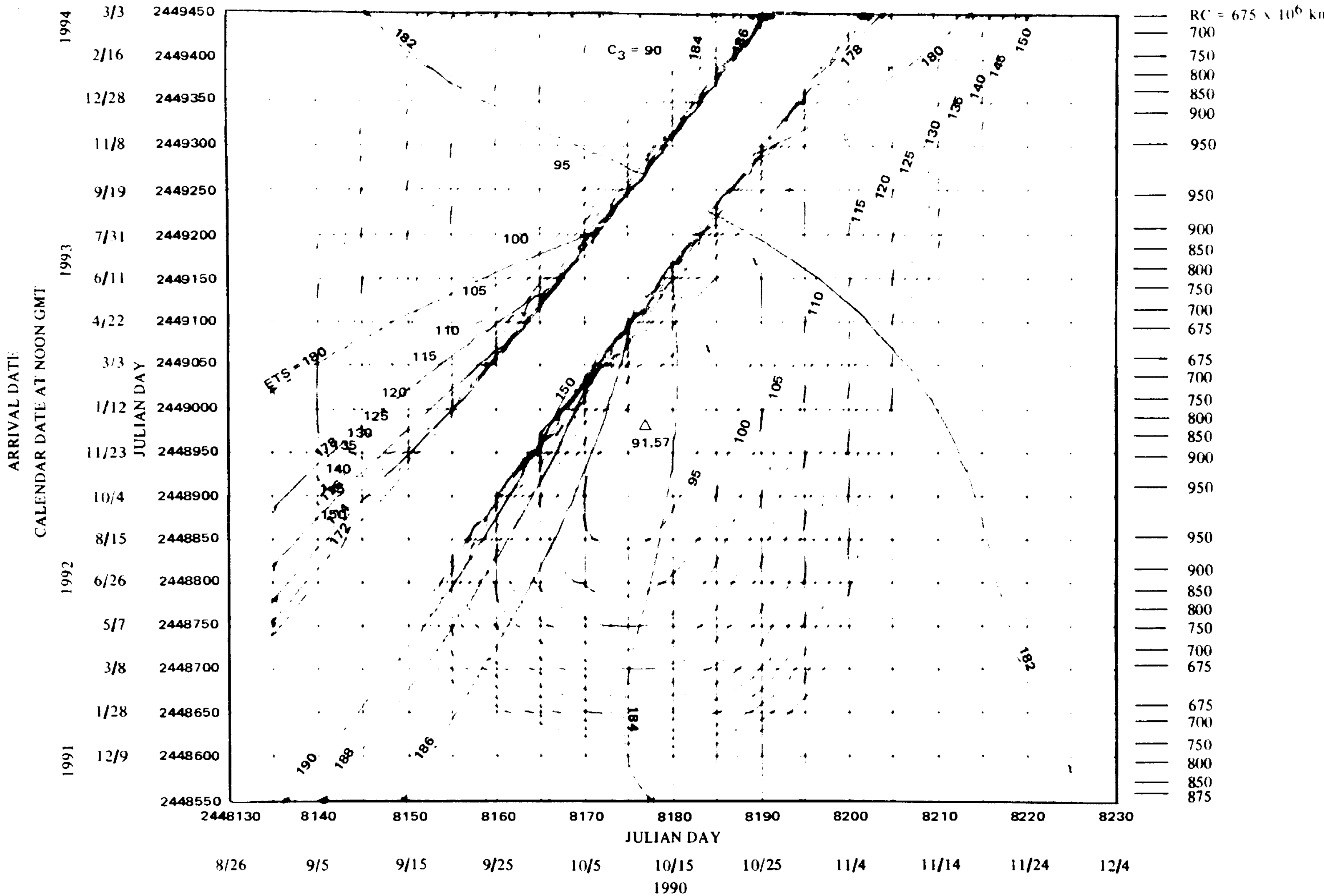

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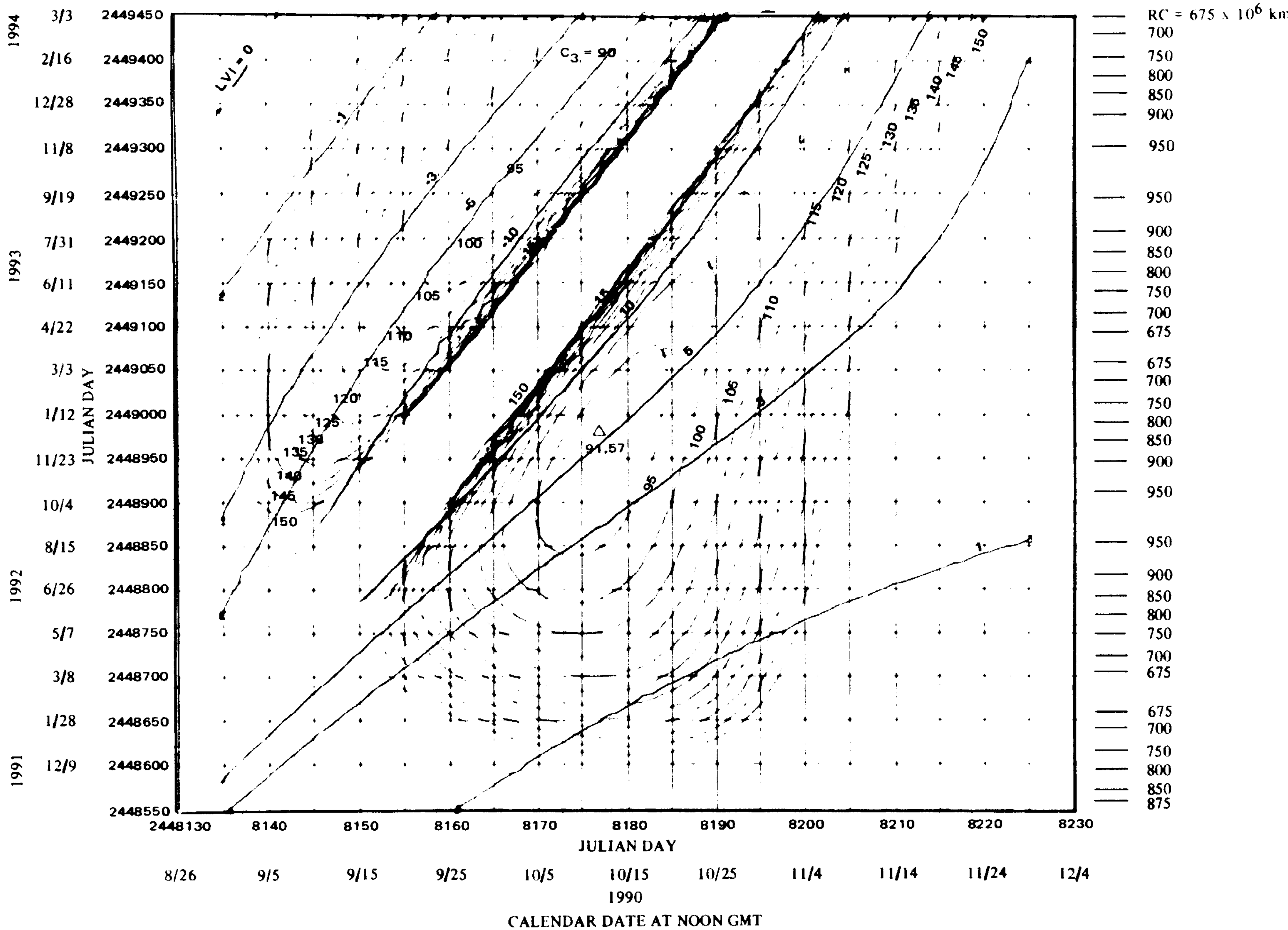
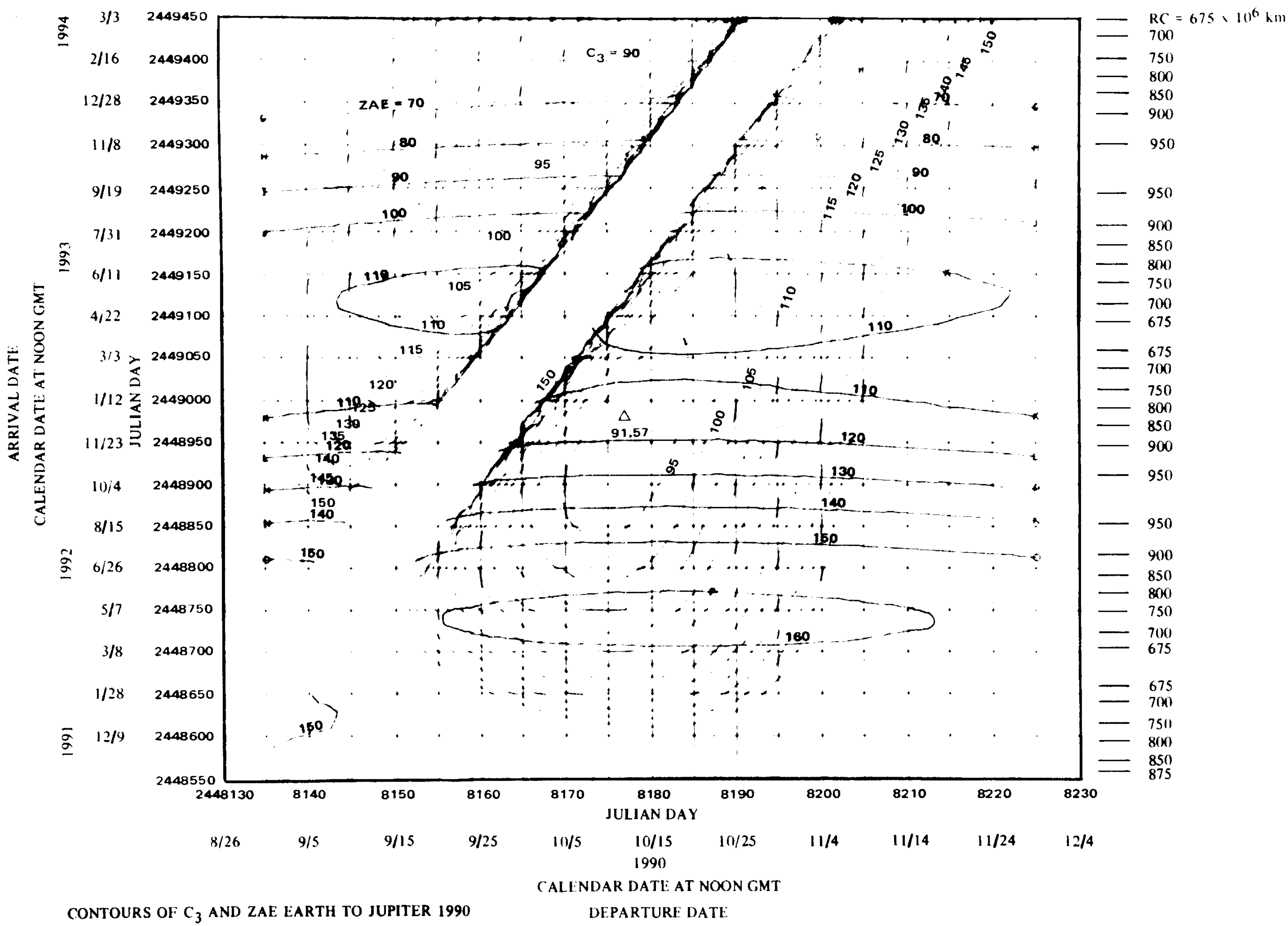


DEPARTURE DATE

CONTOURS OF C_3 AND LVI EARTH TO JUPITER 1990



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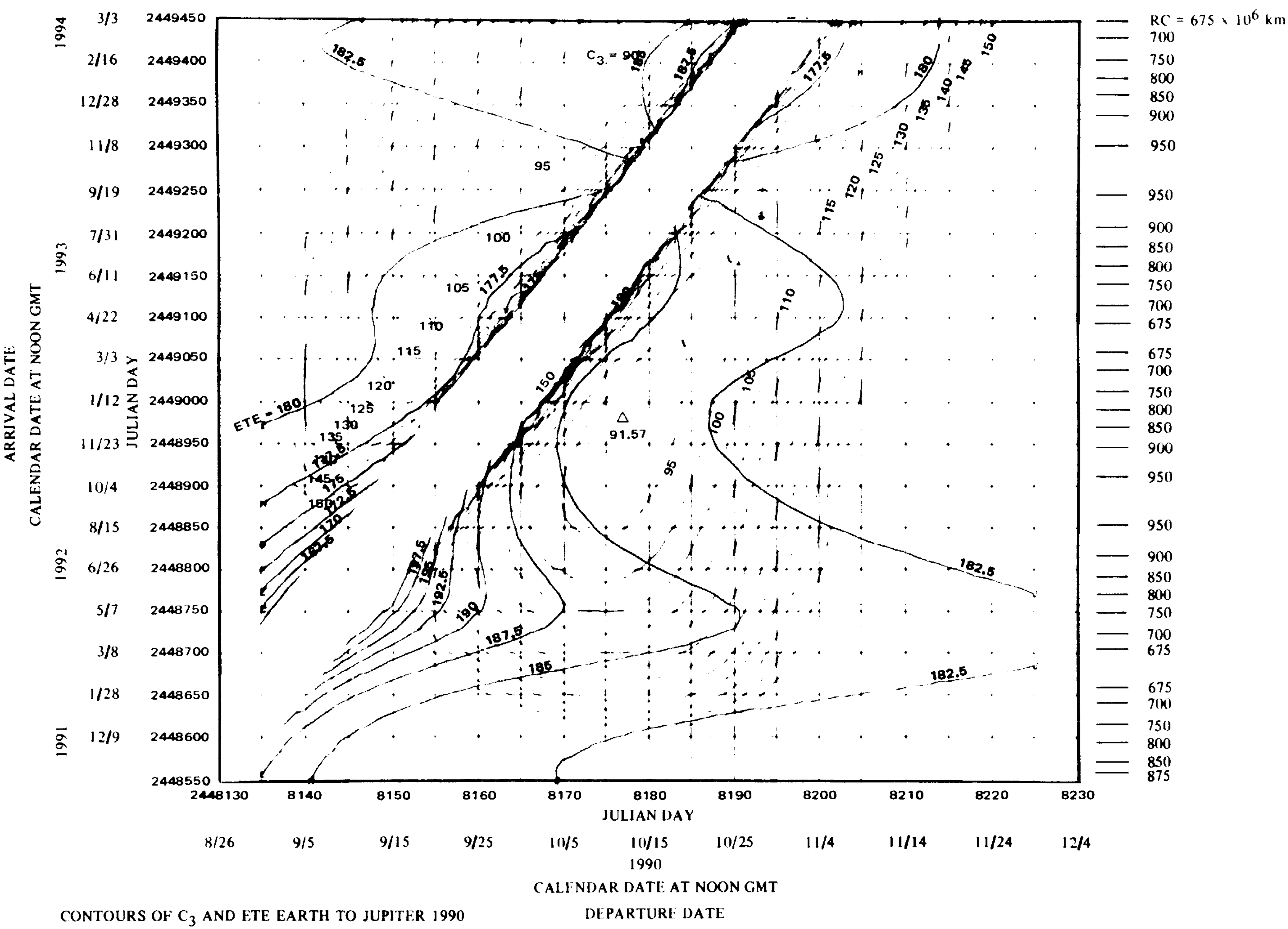

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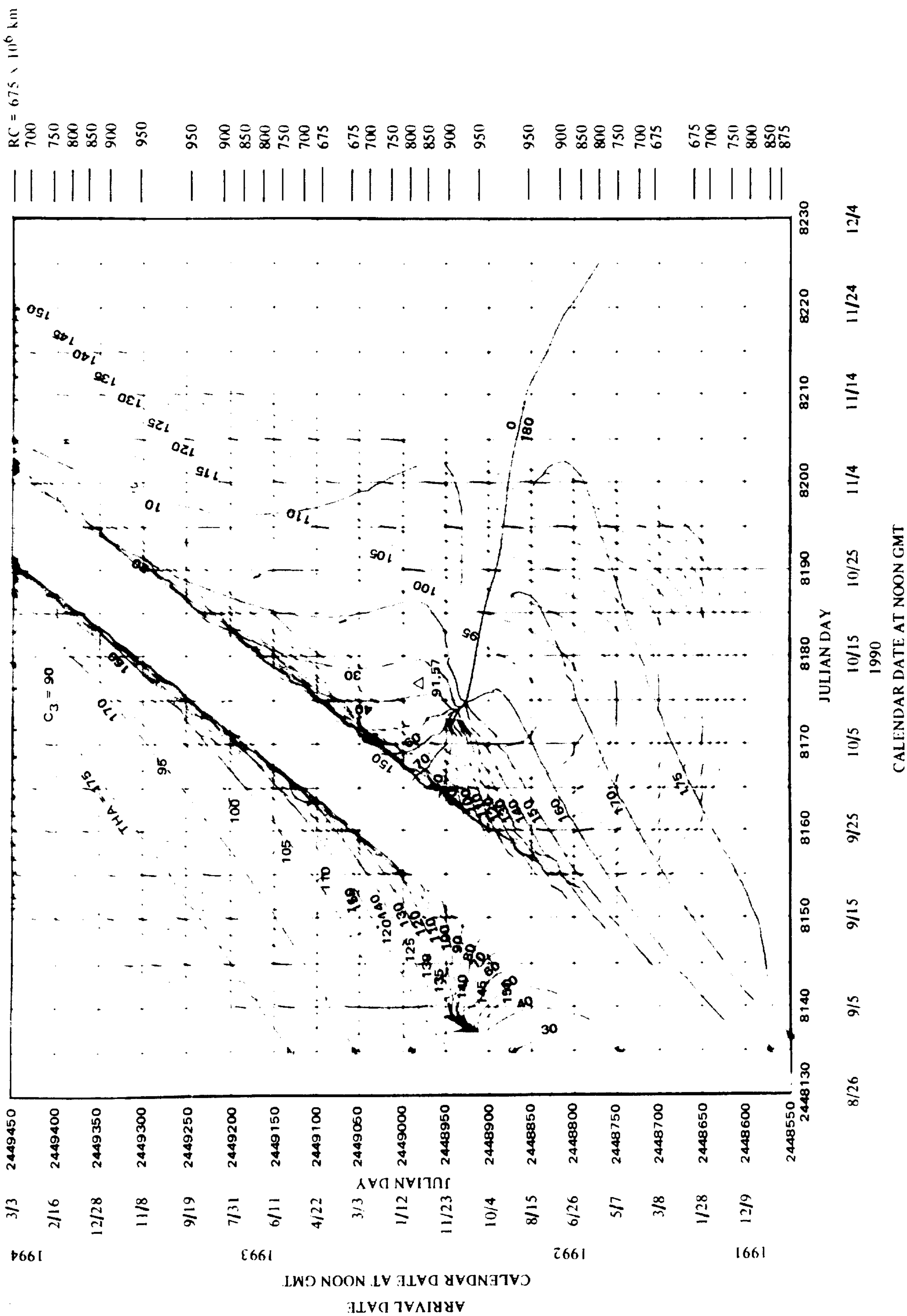

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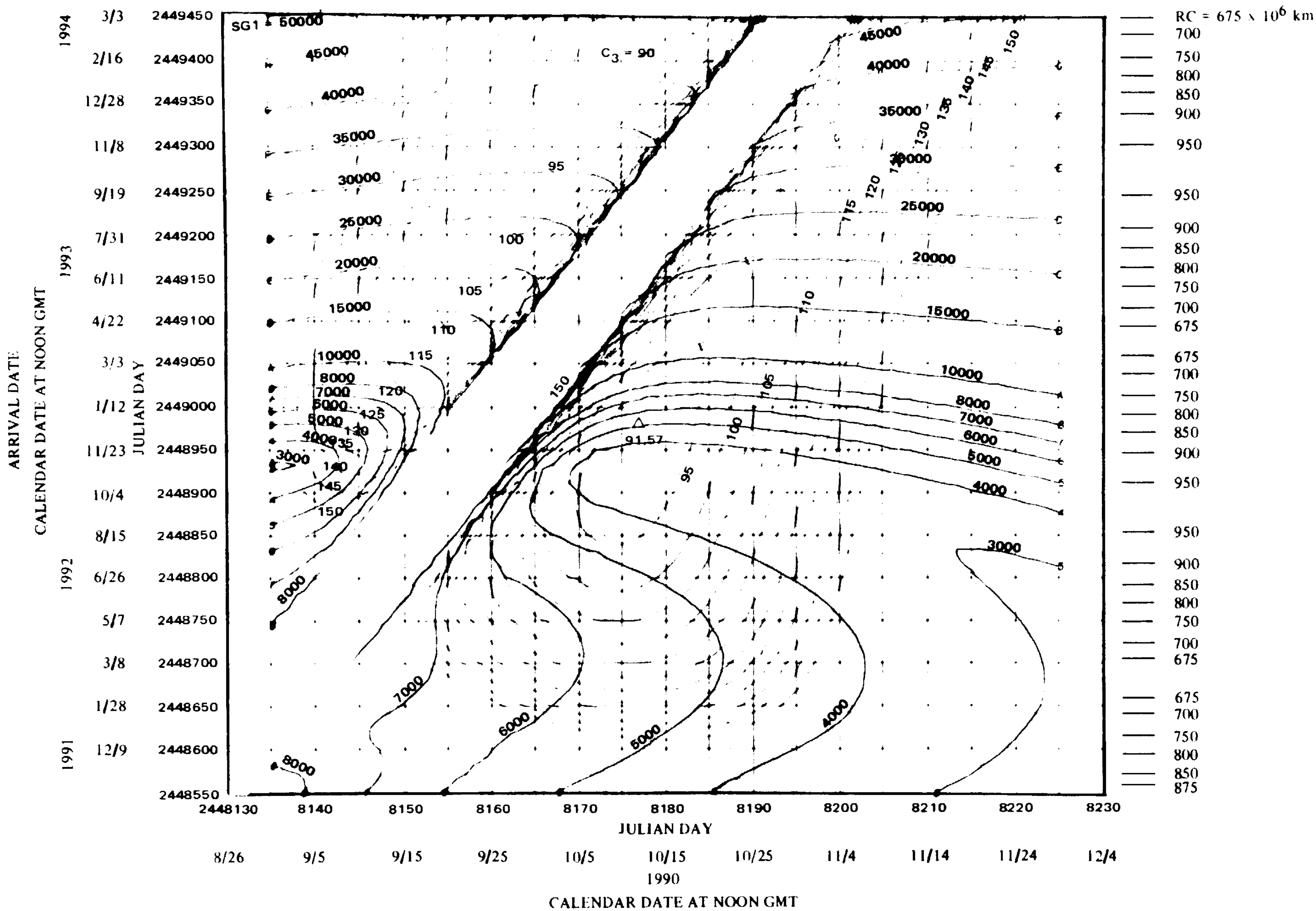

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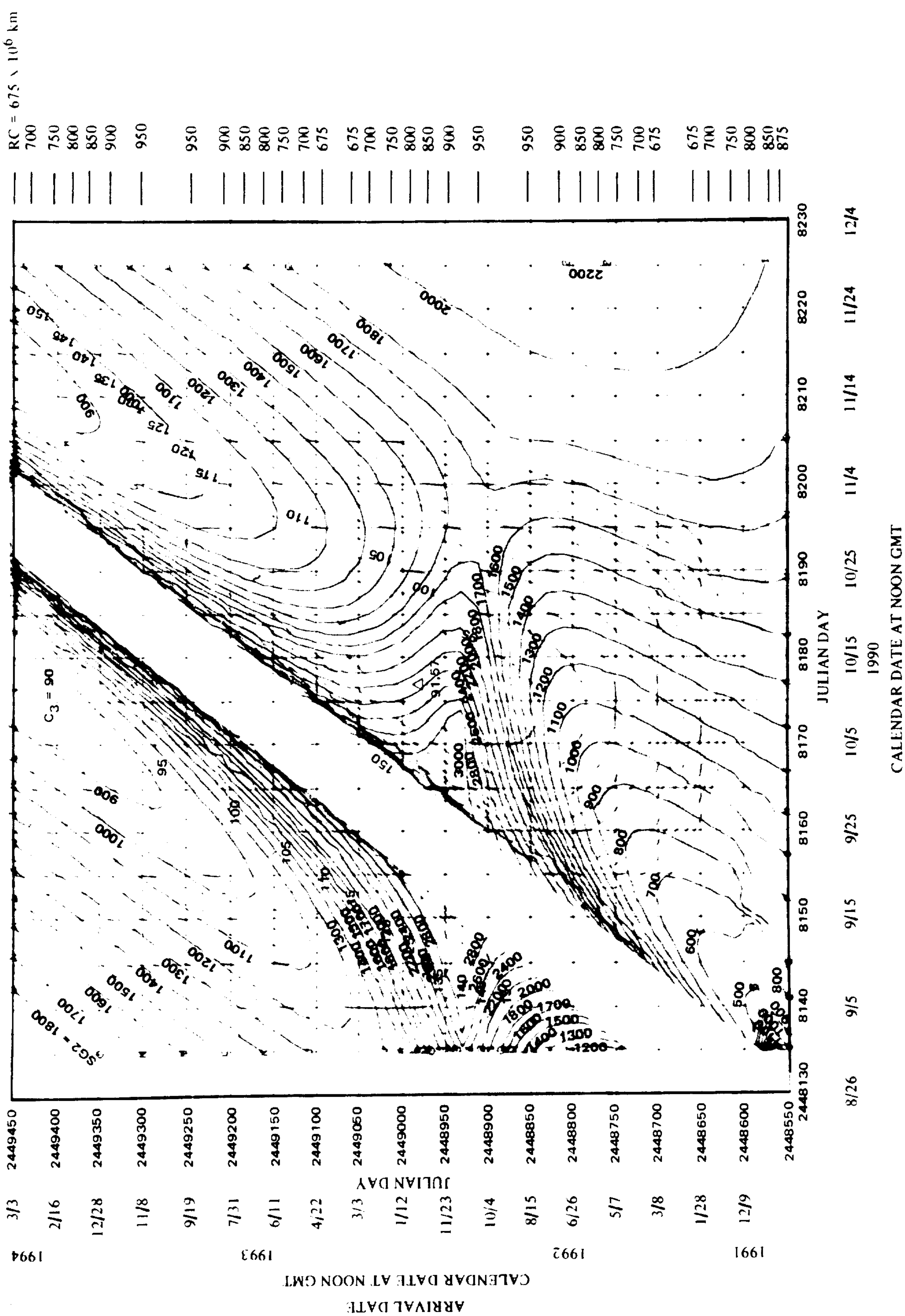

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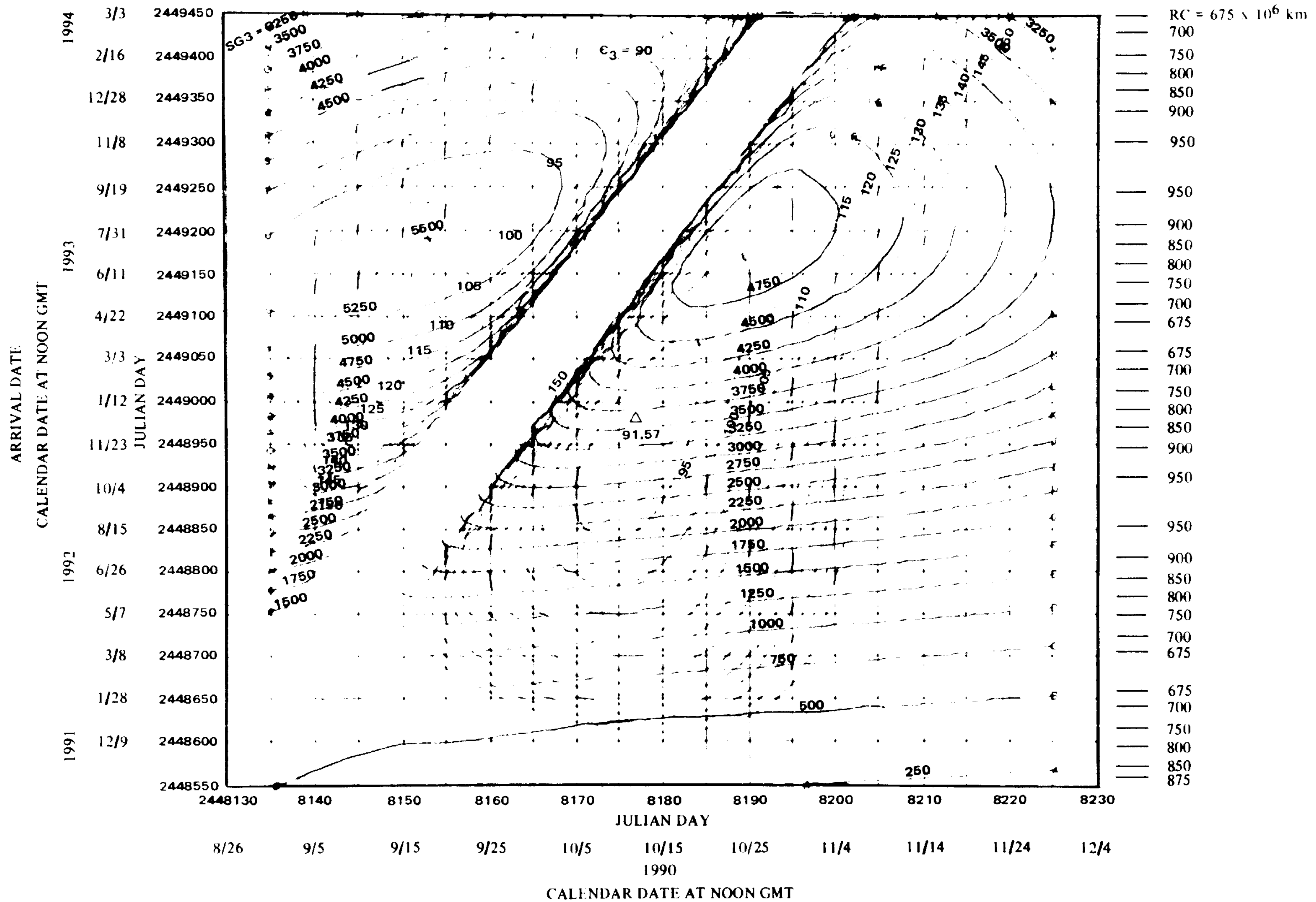

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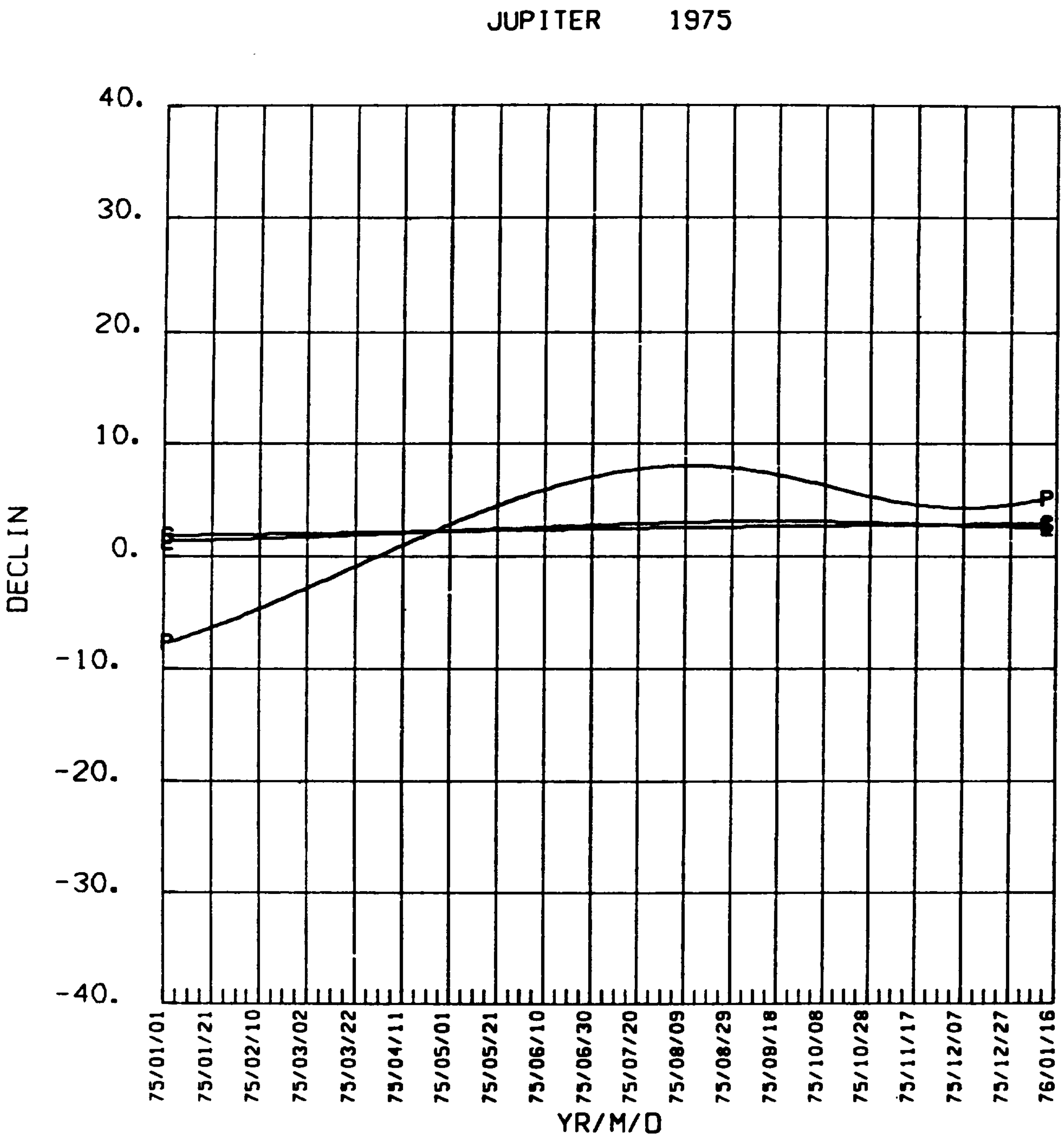
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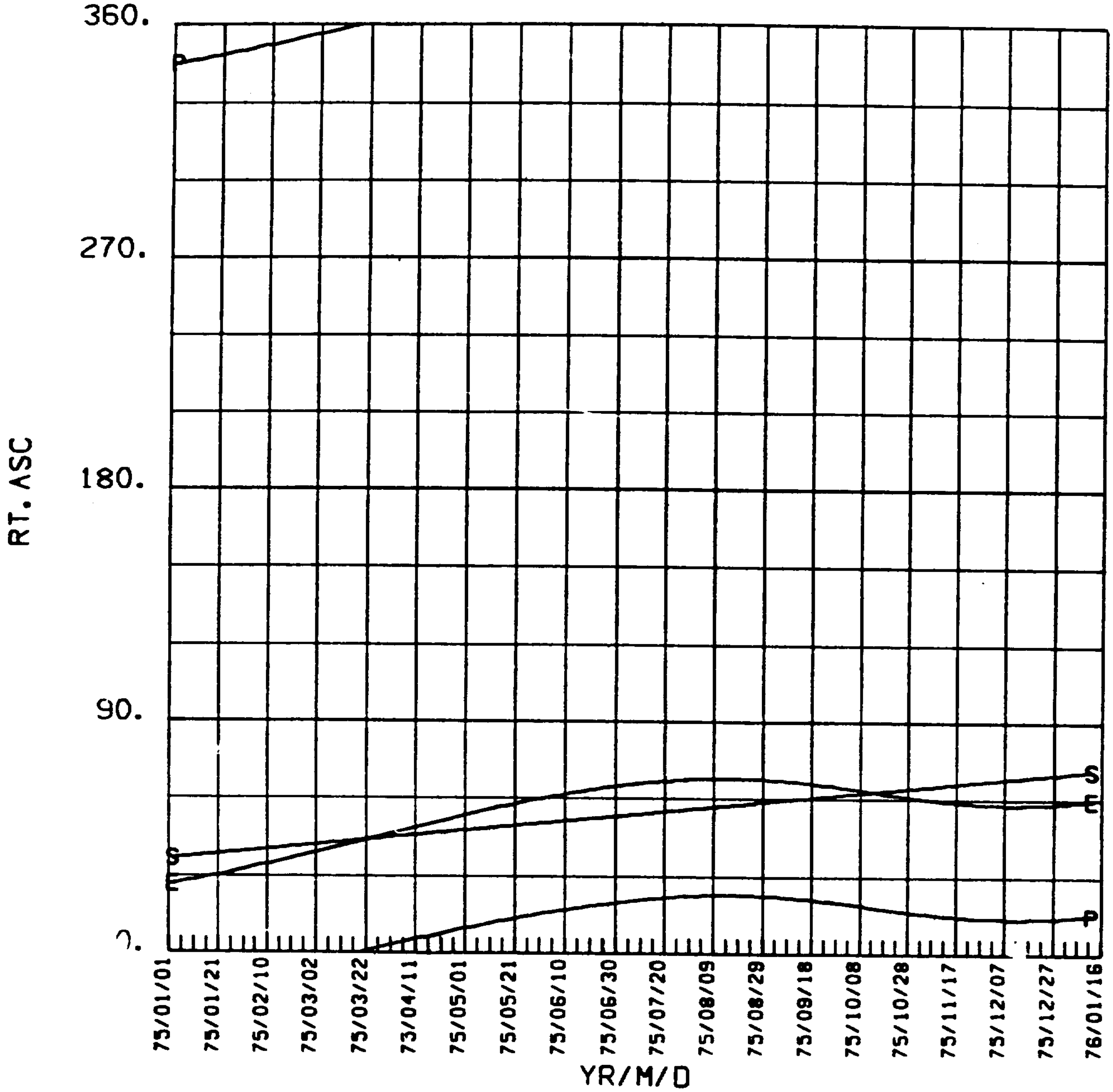

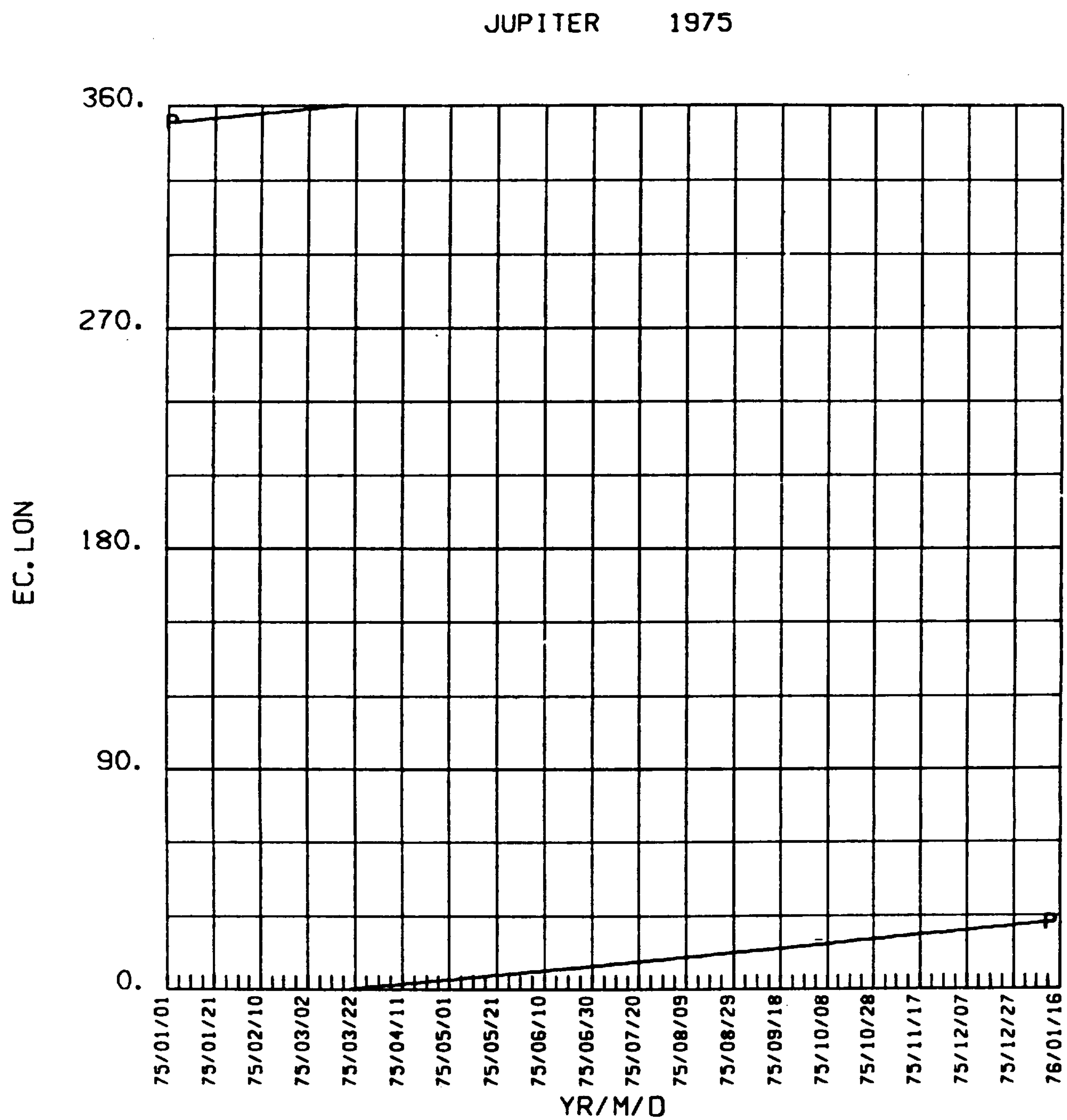
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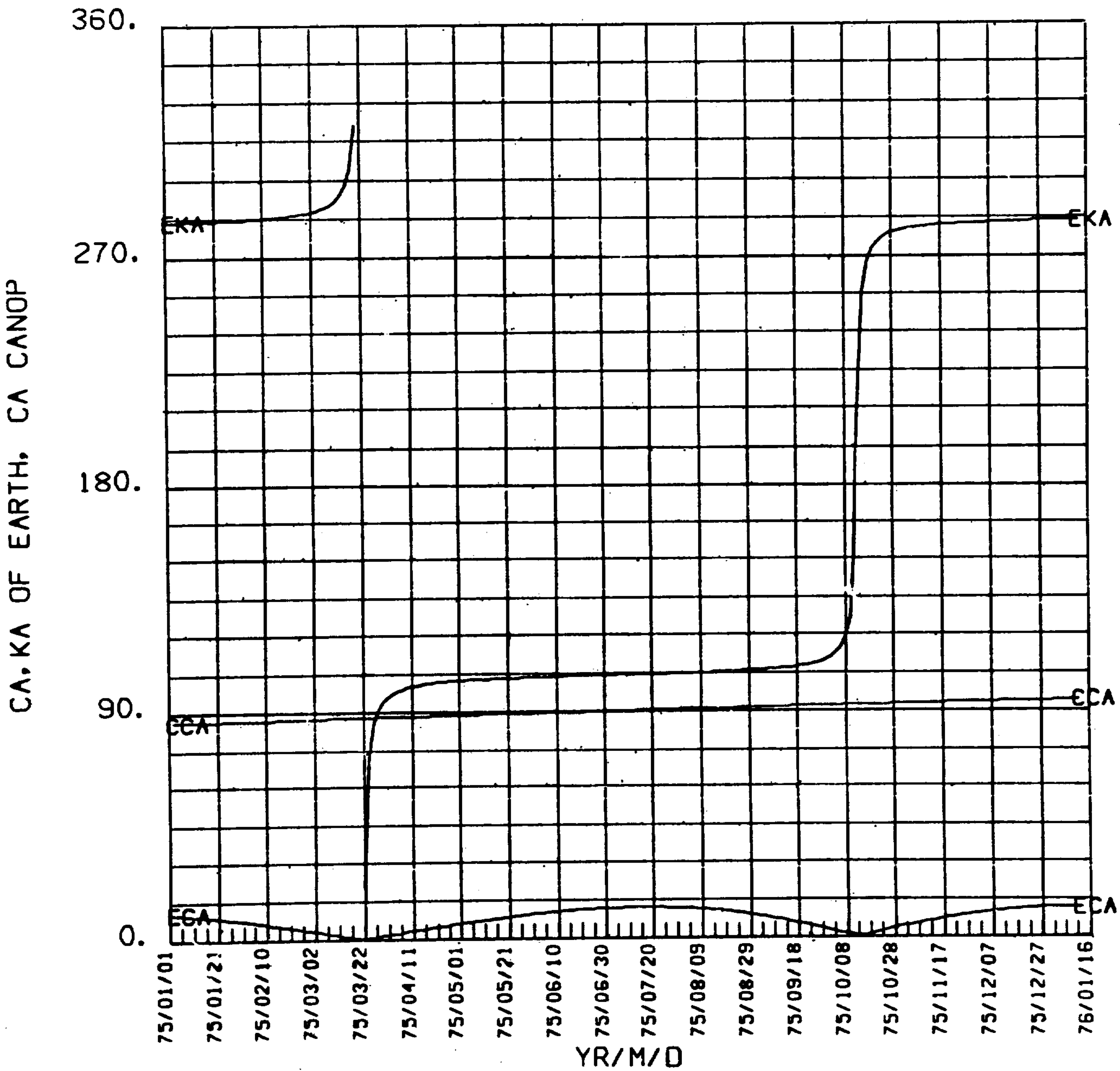

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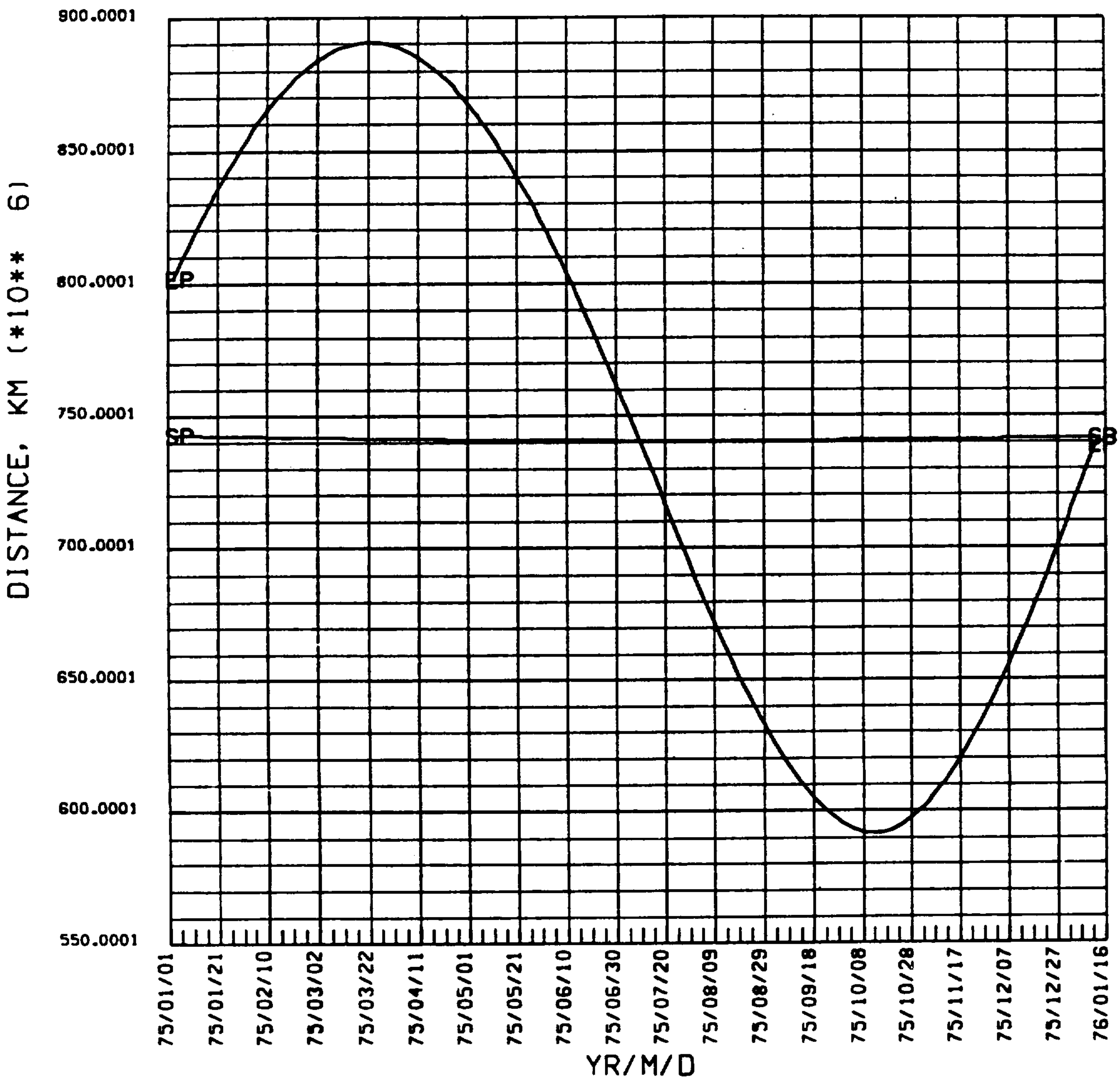

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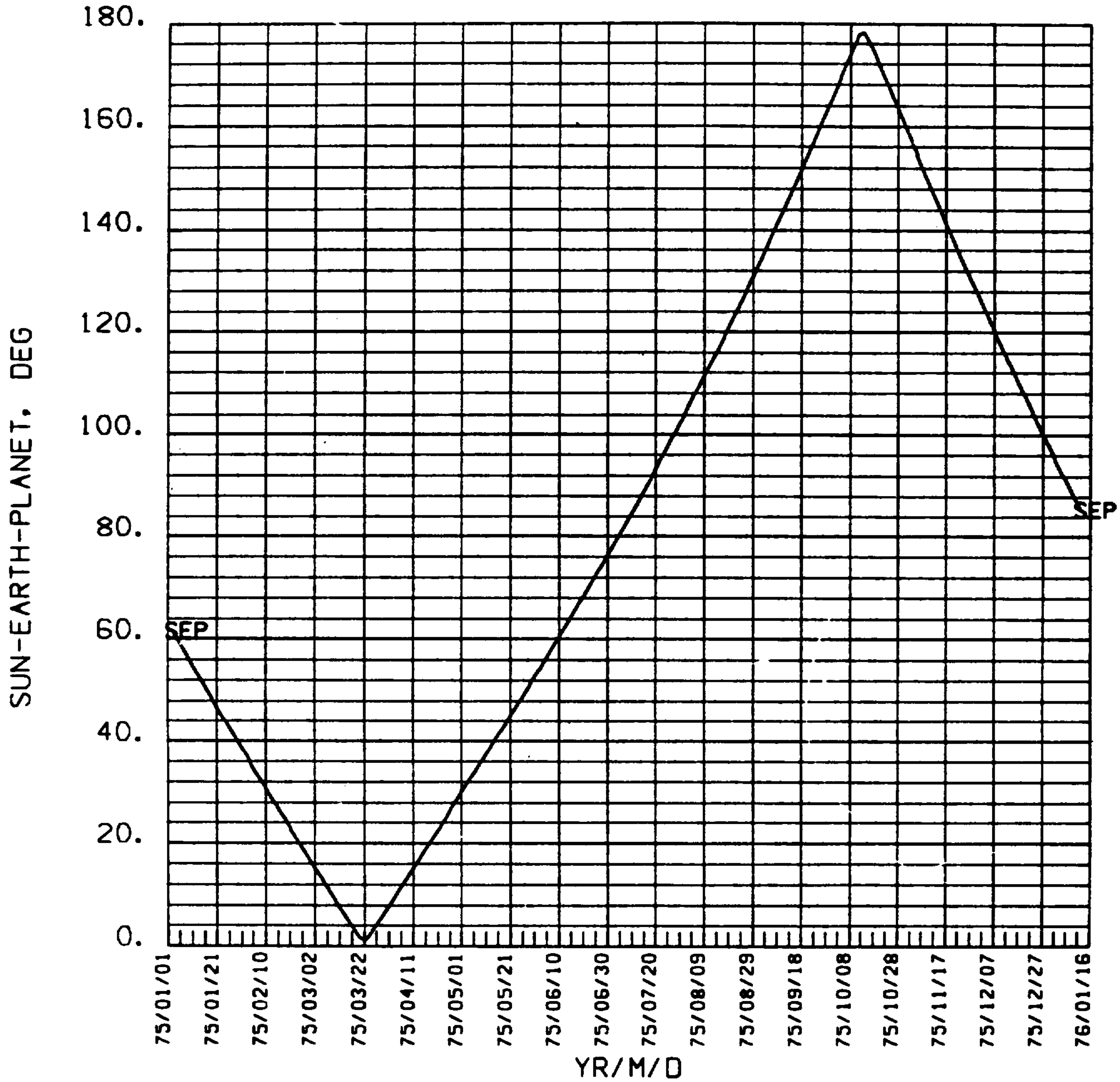
JUPITER 1975



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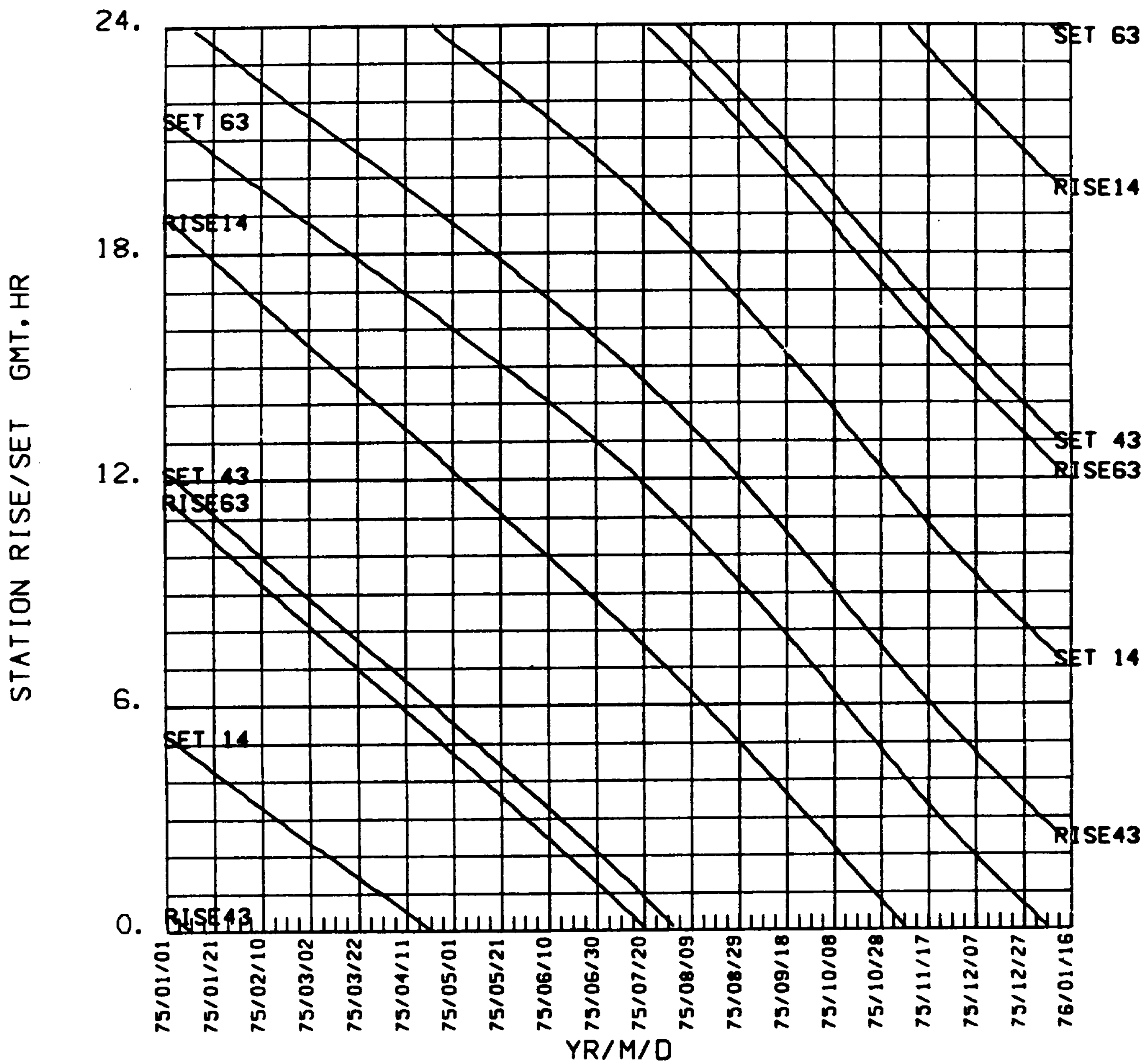

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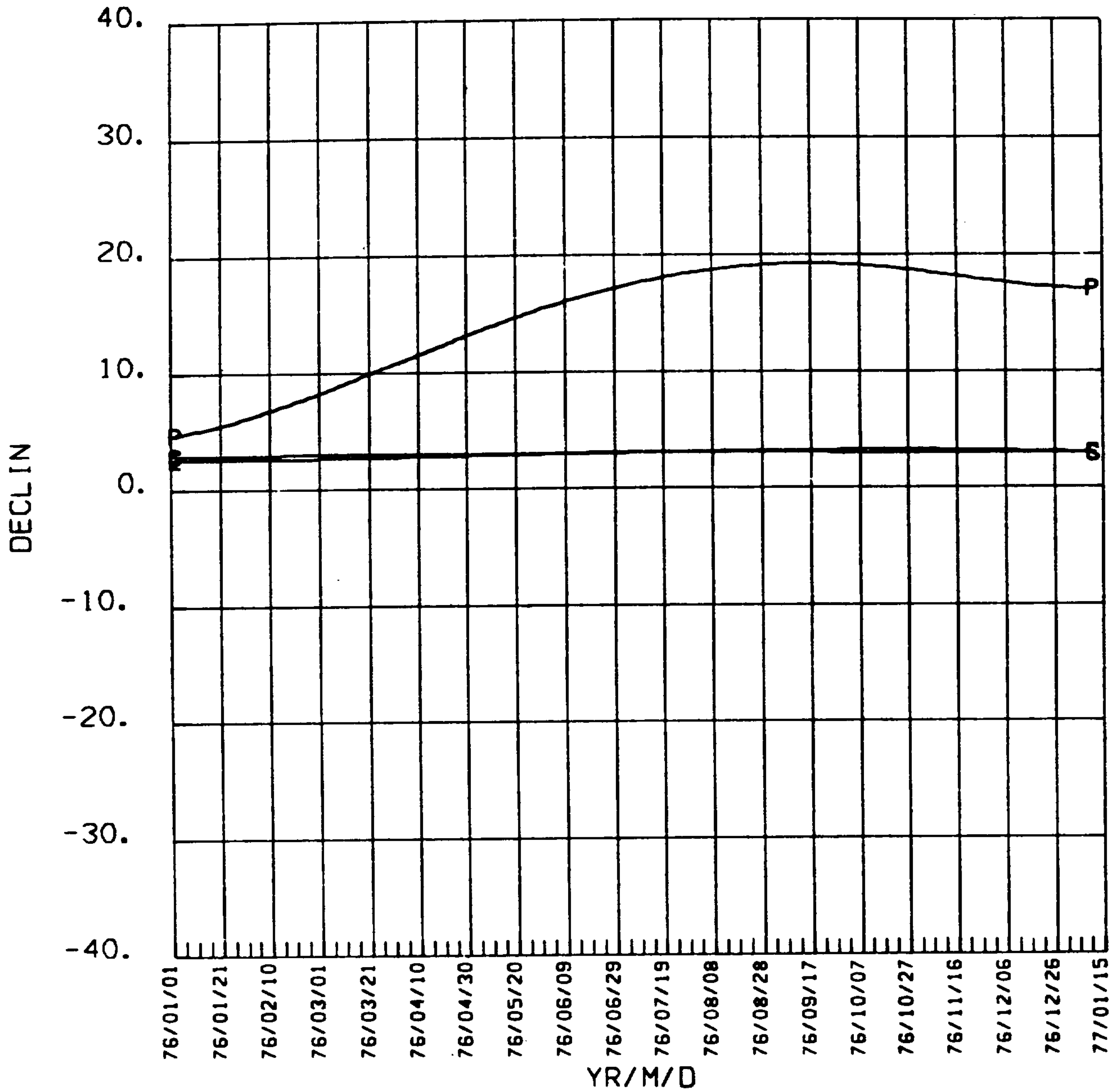

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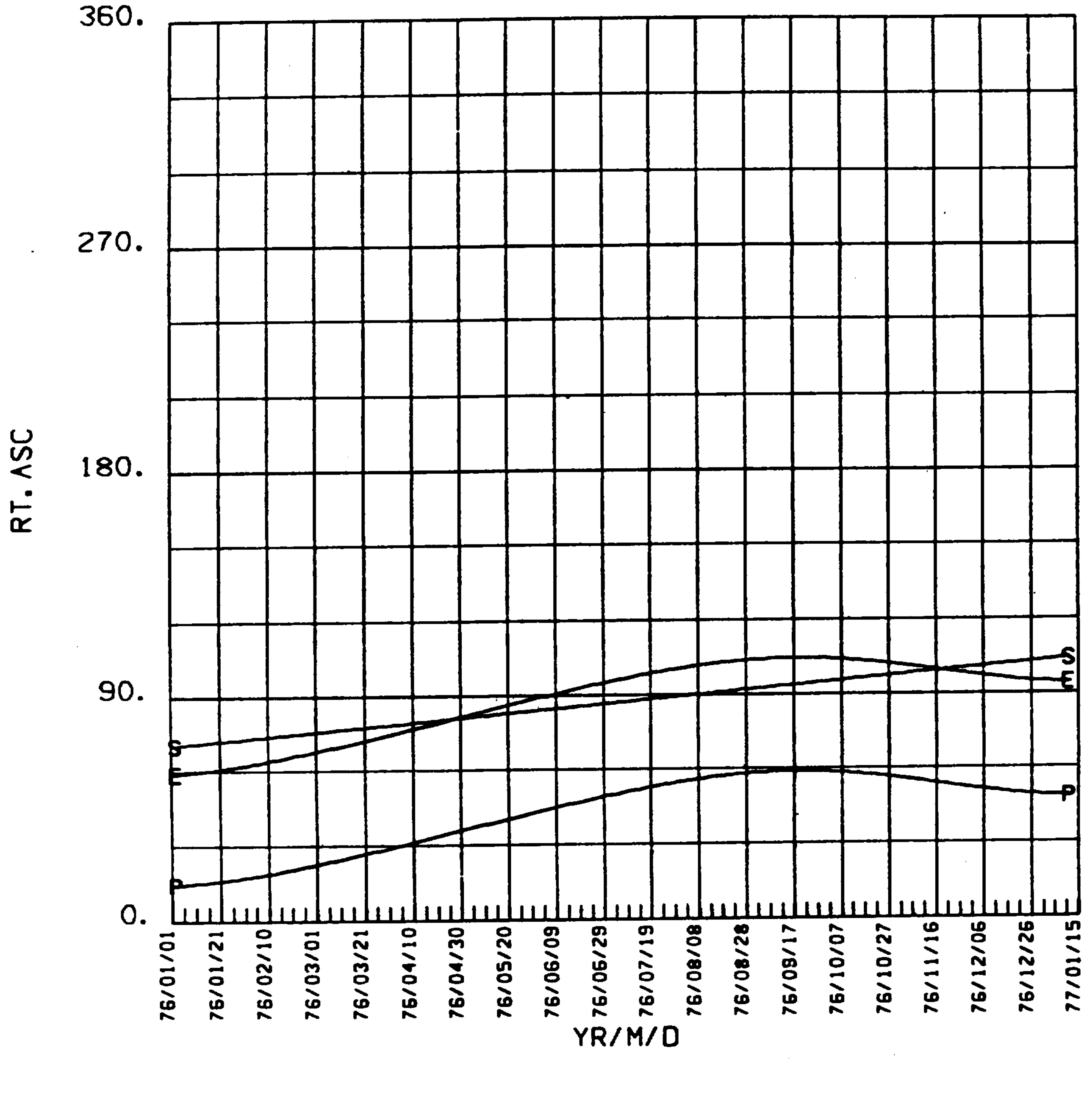

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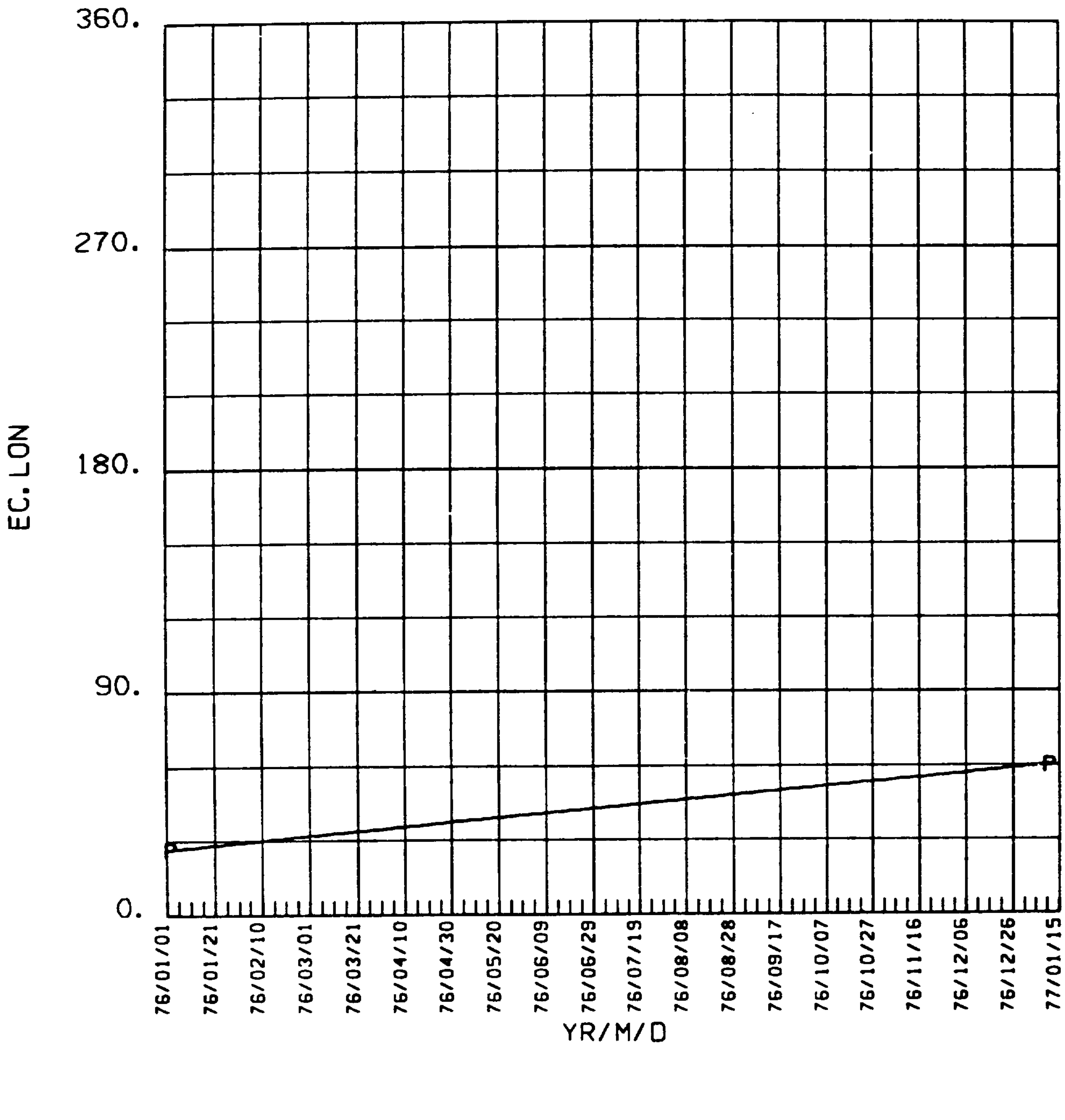

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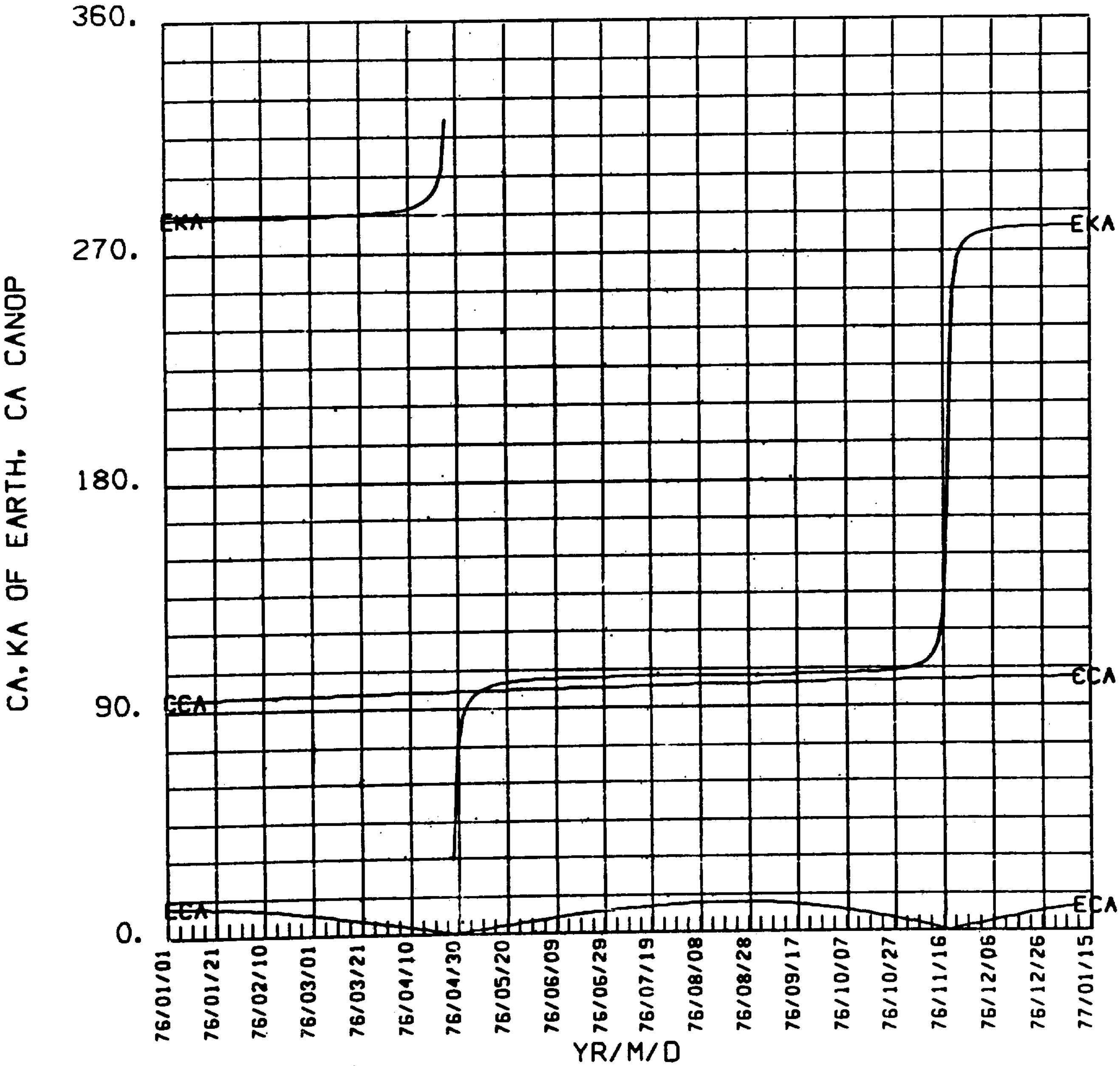

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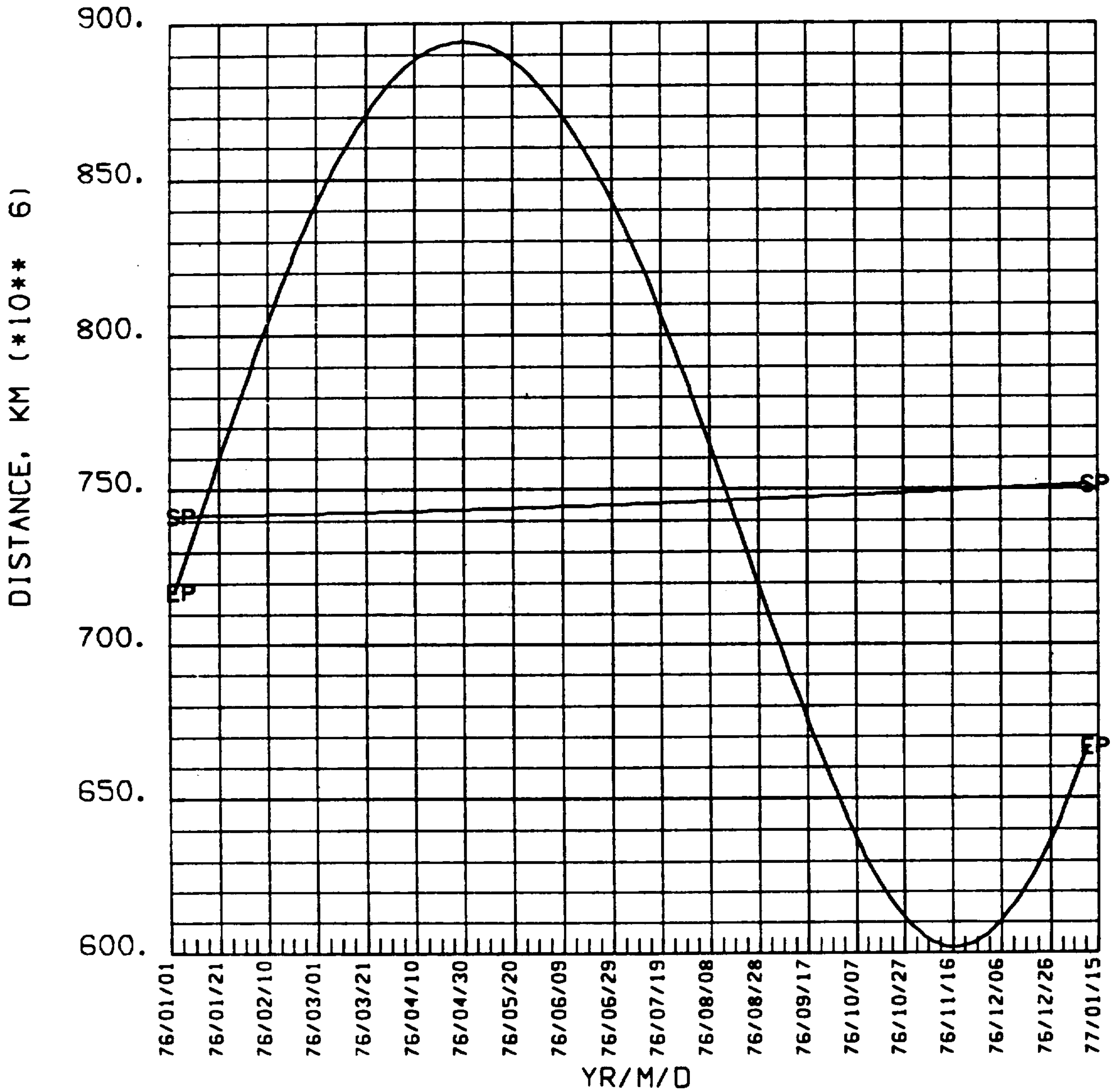

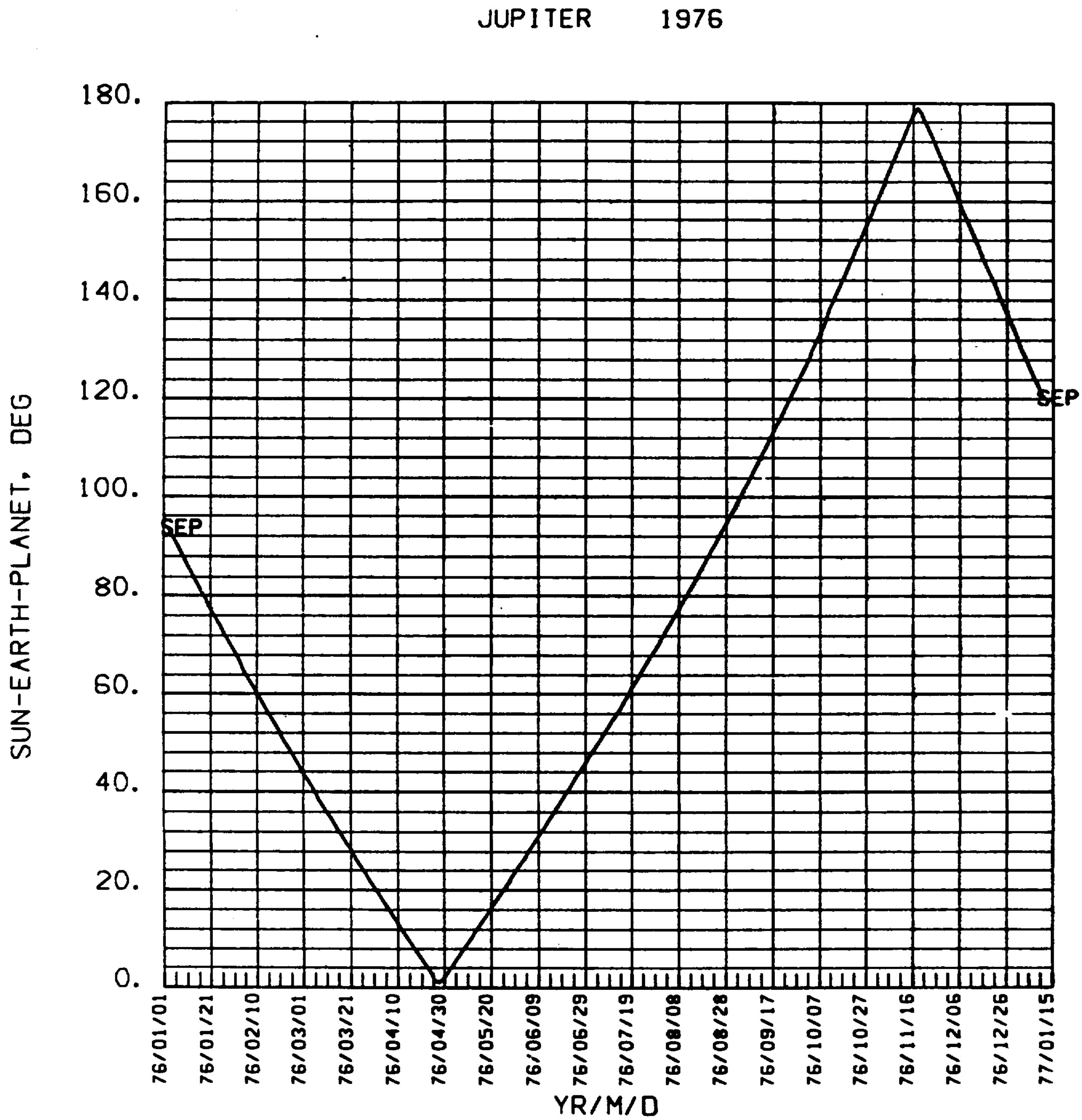
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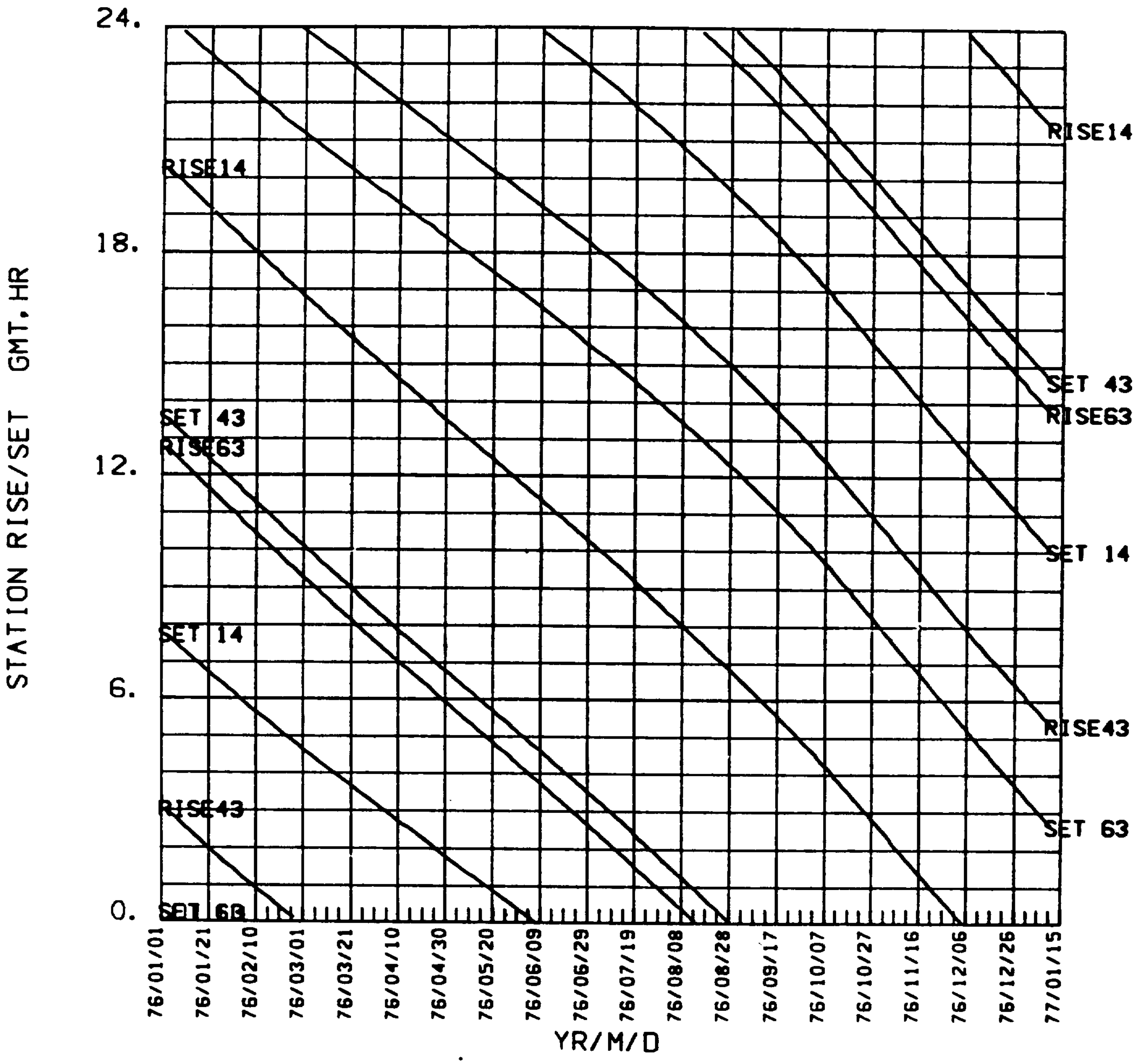

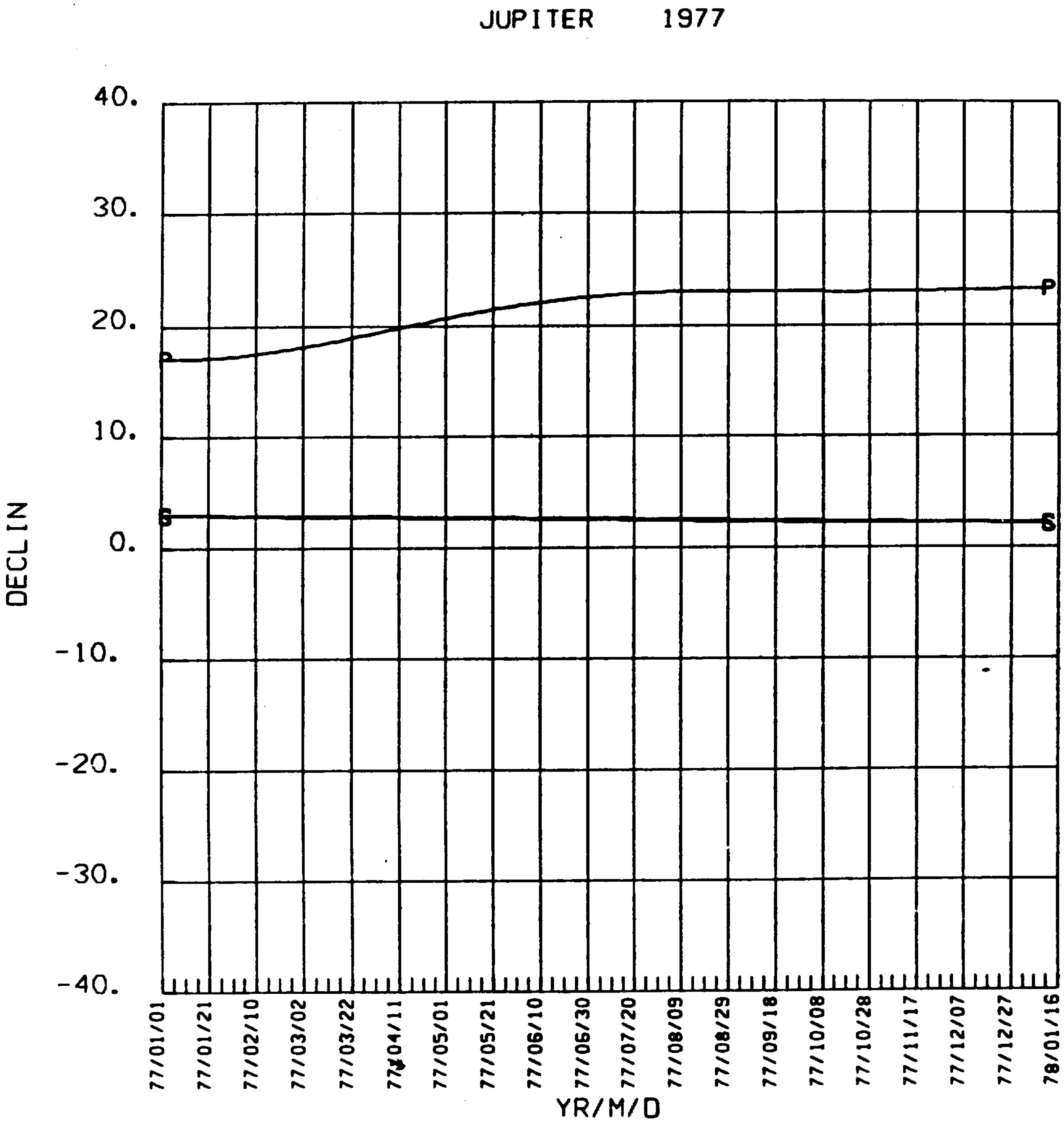
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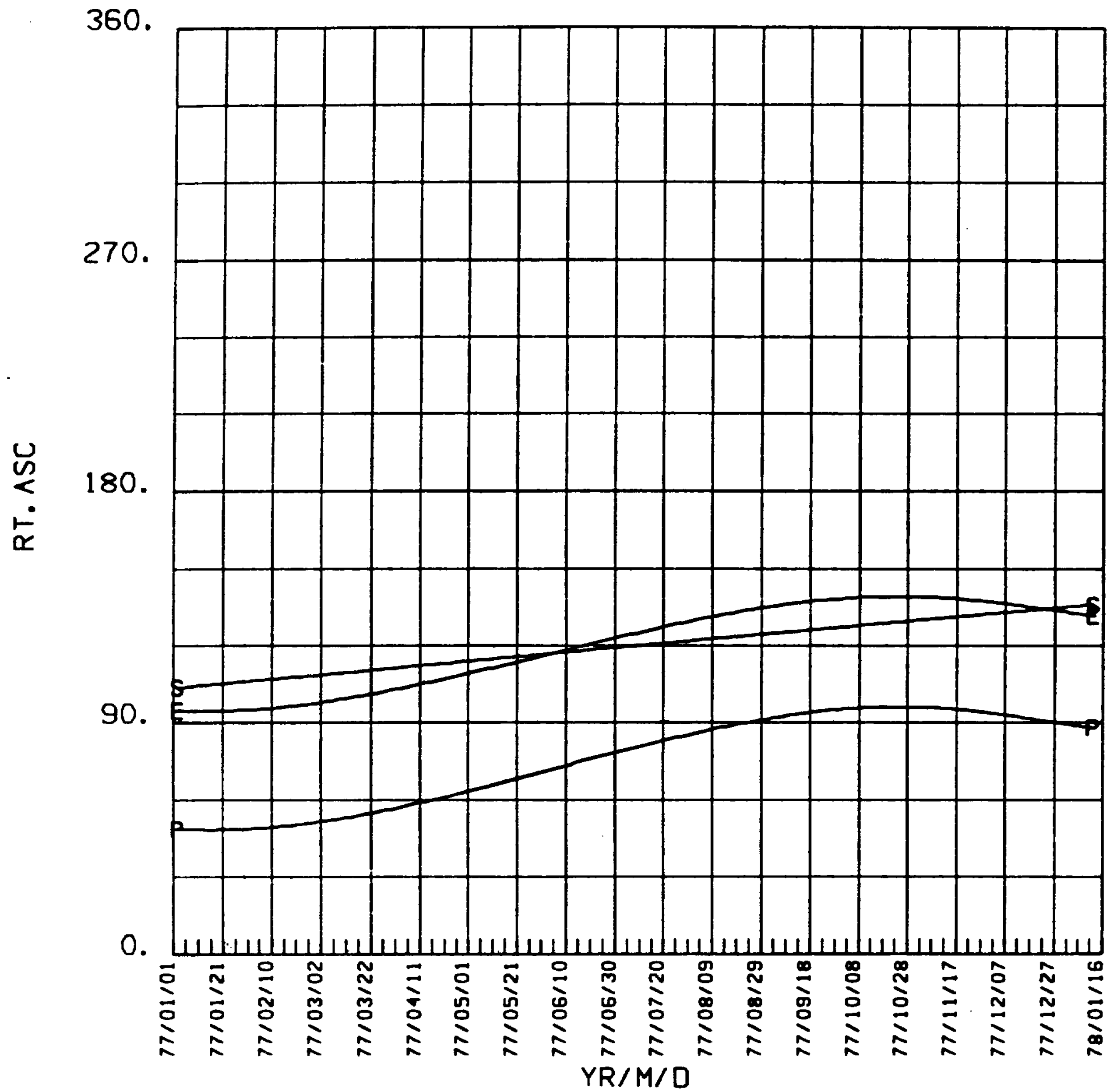

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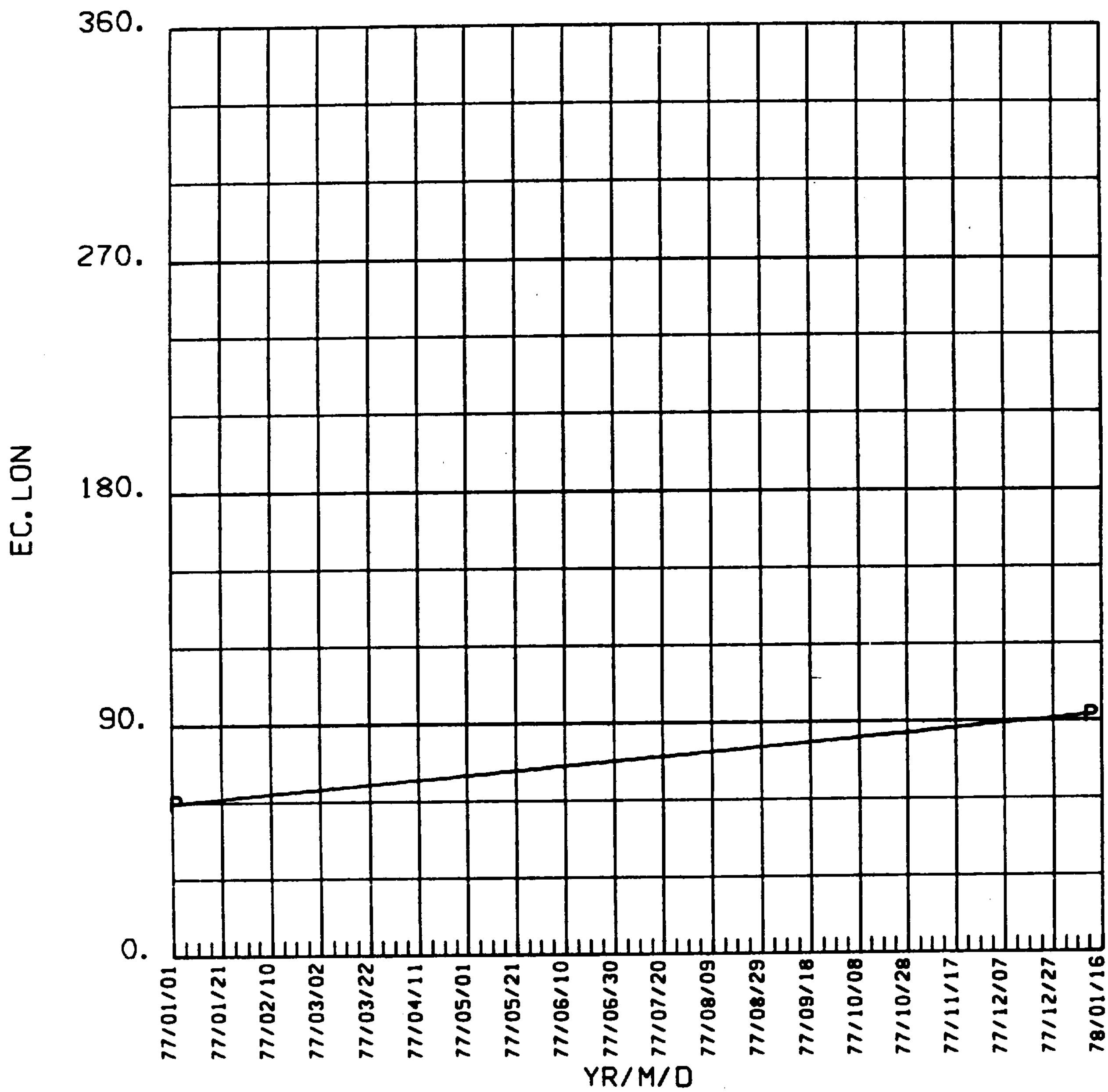

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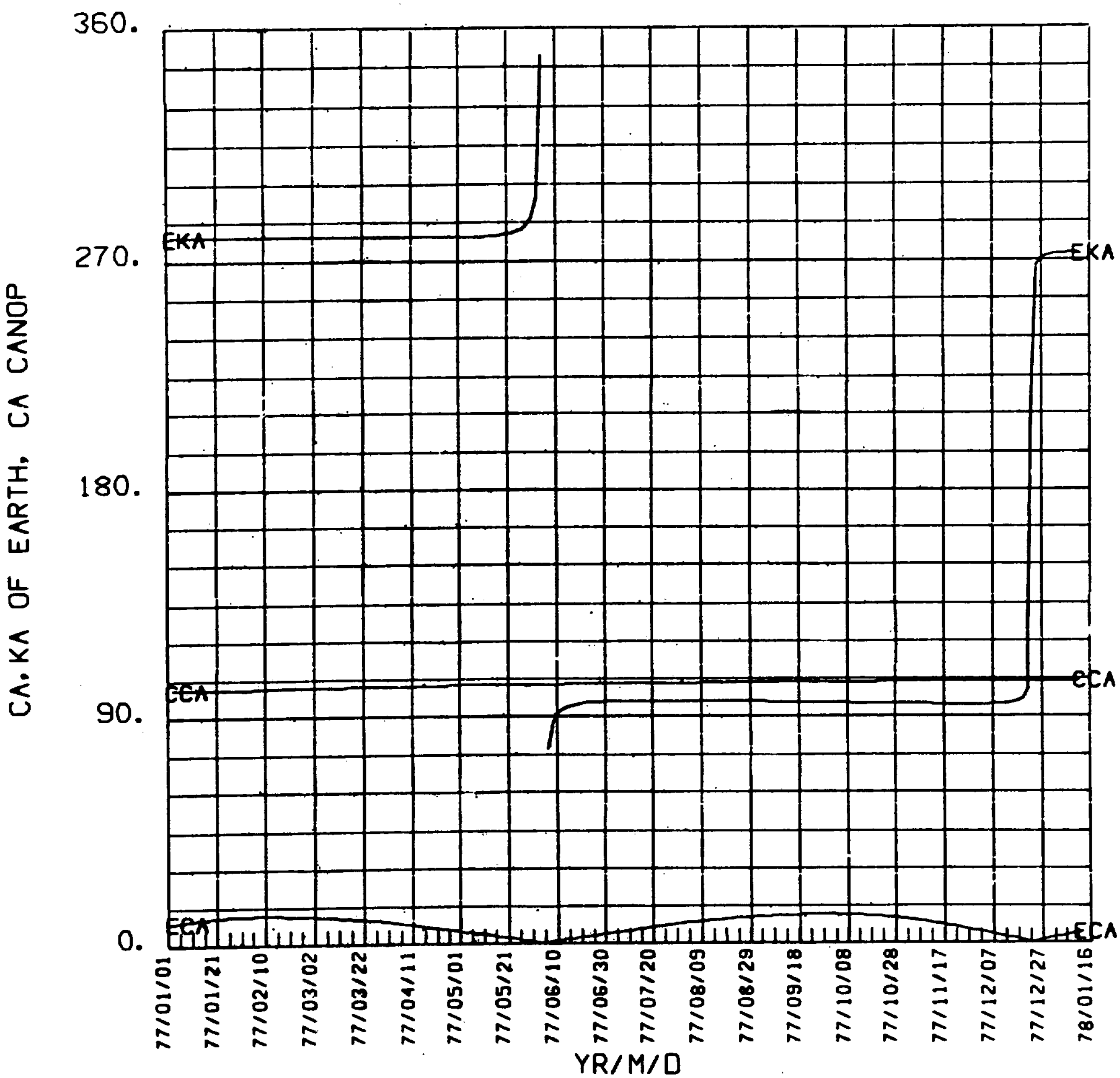

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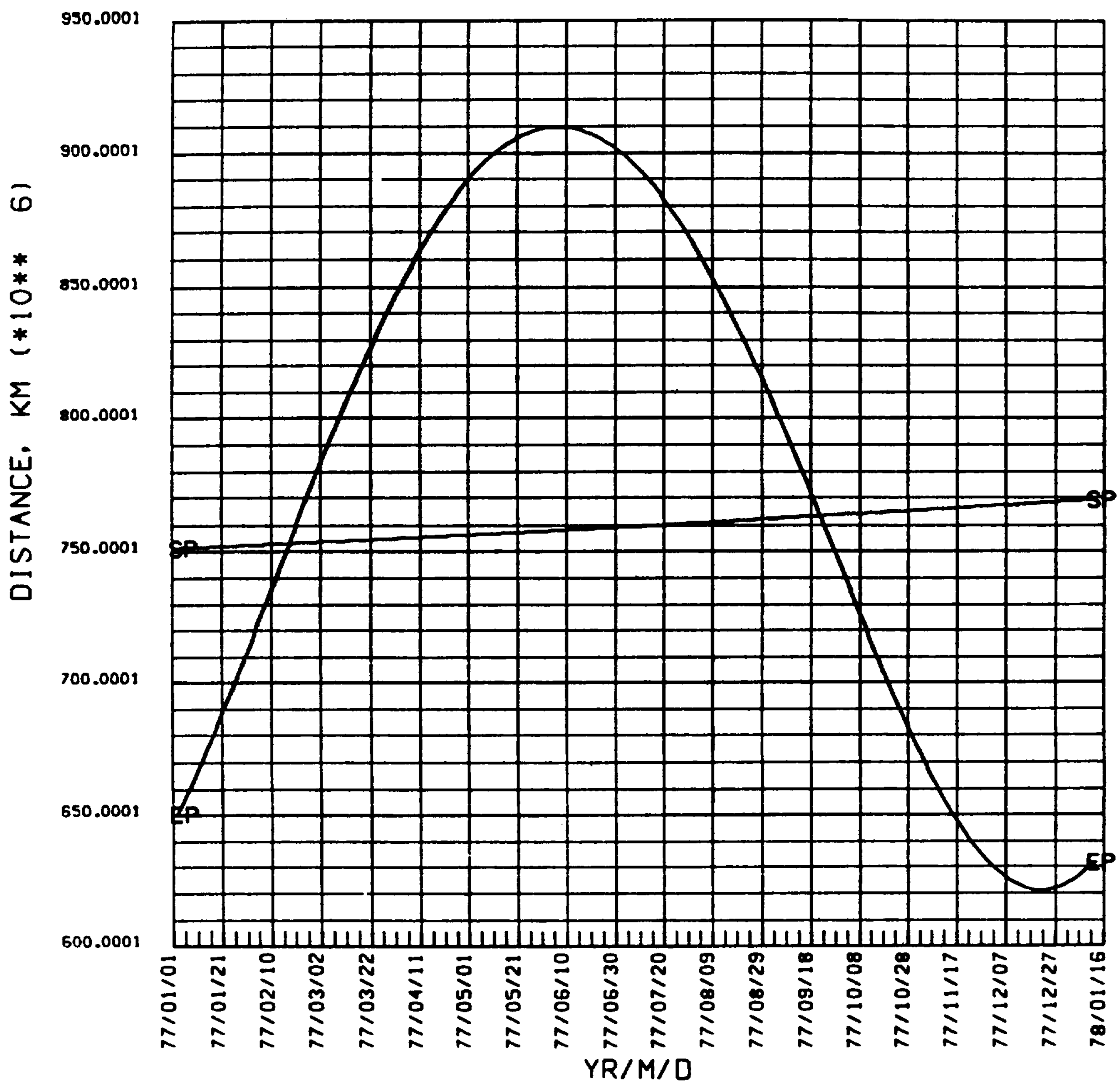

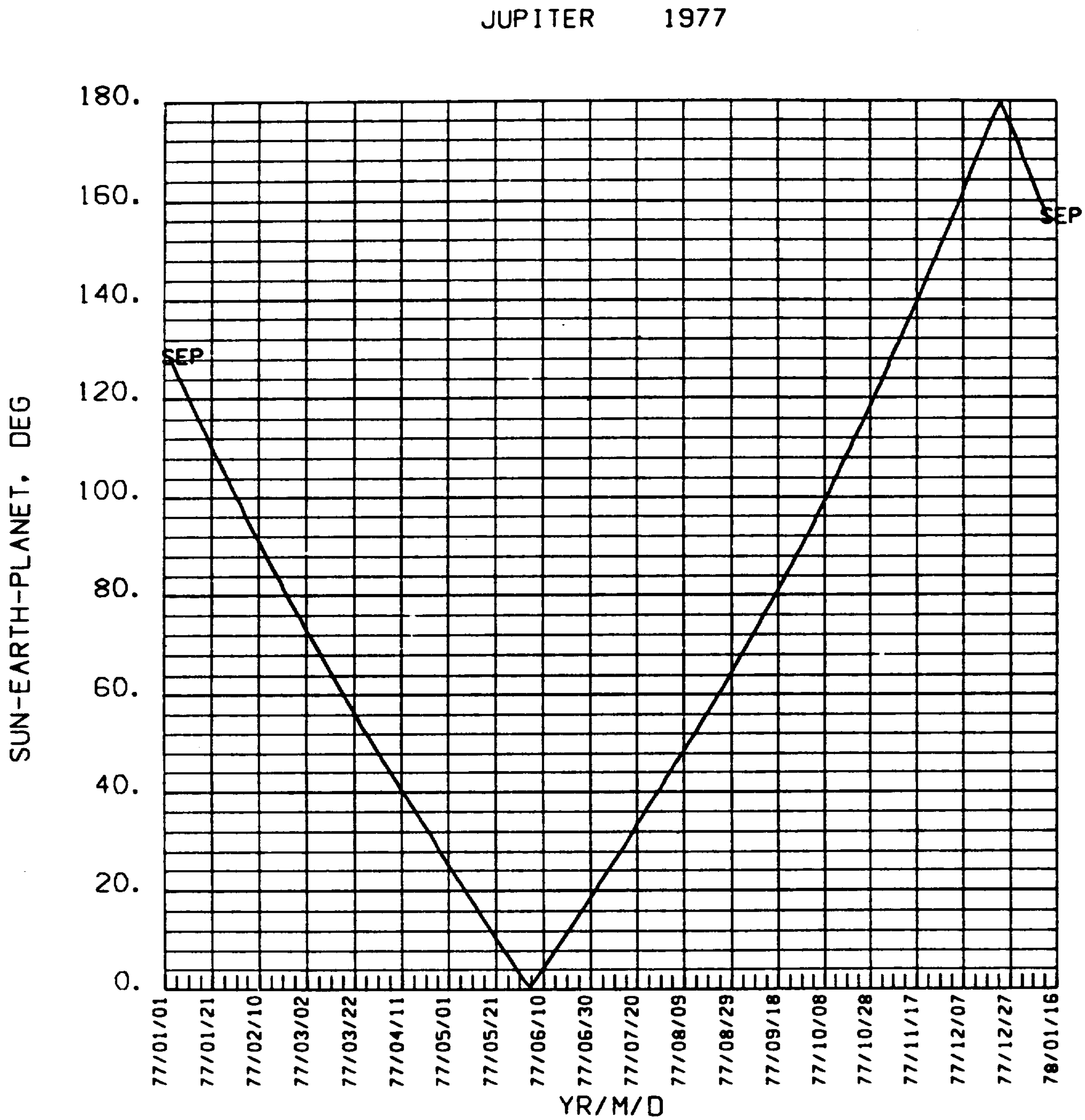
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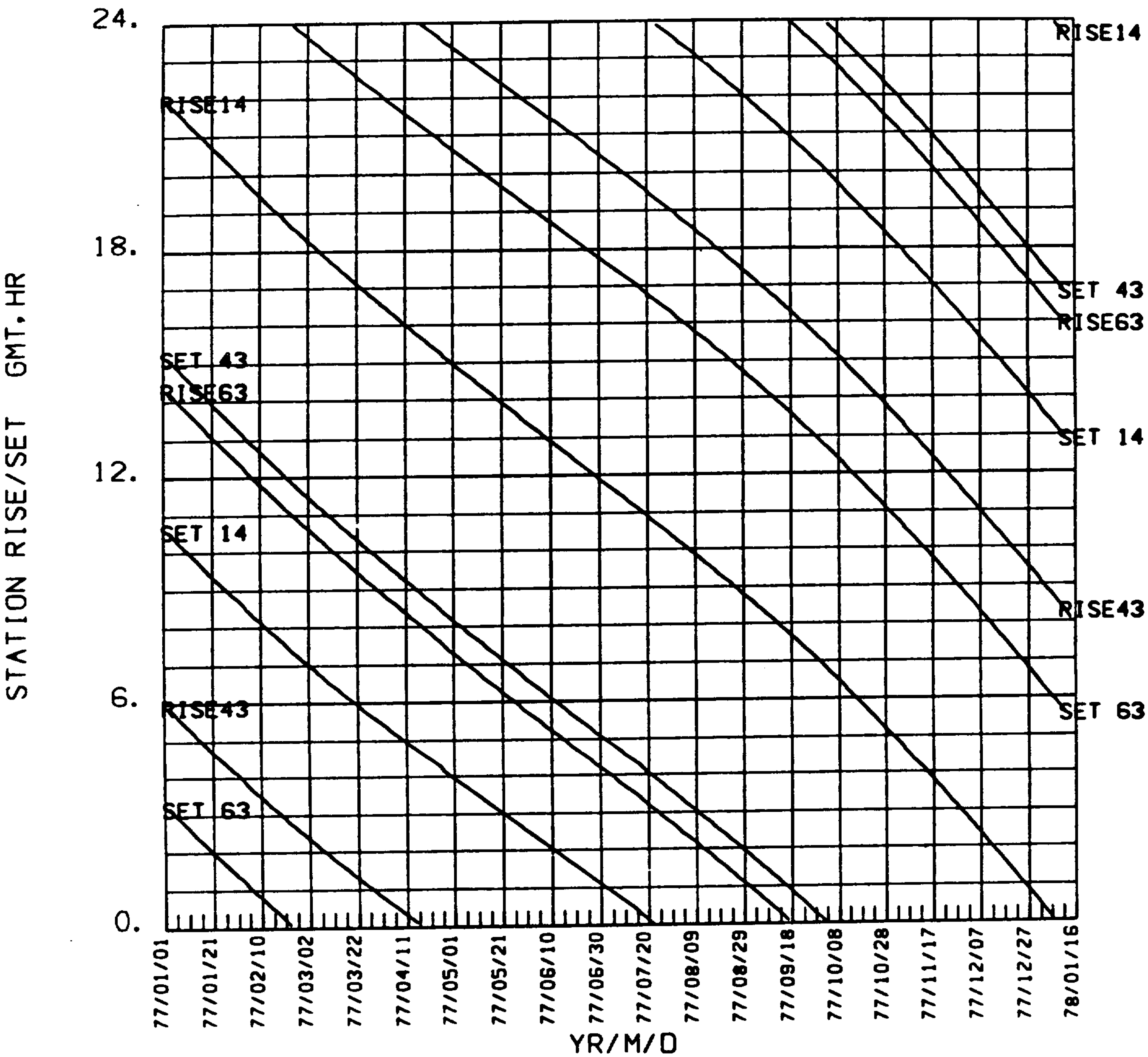

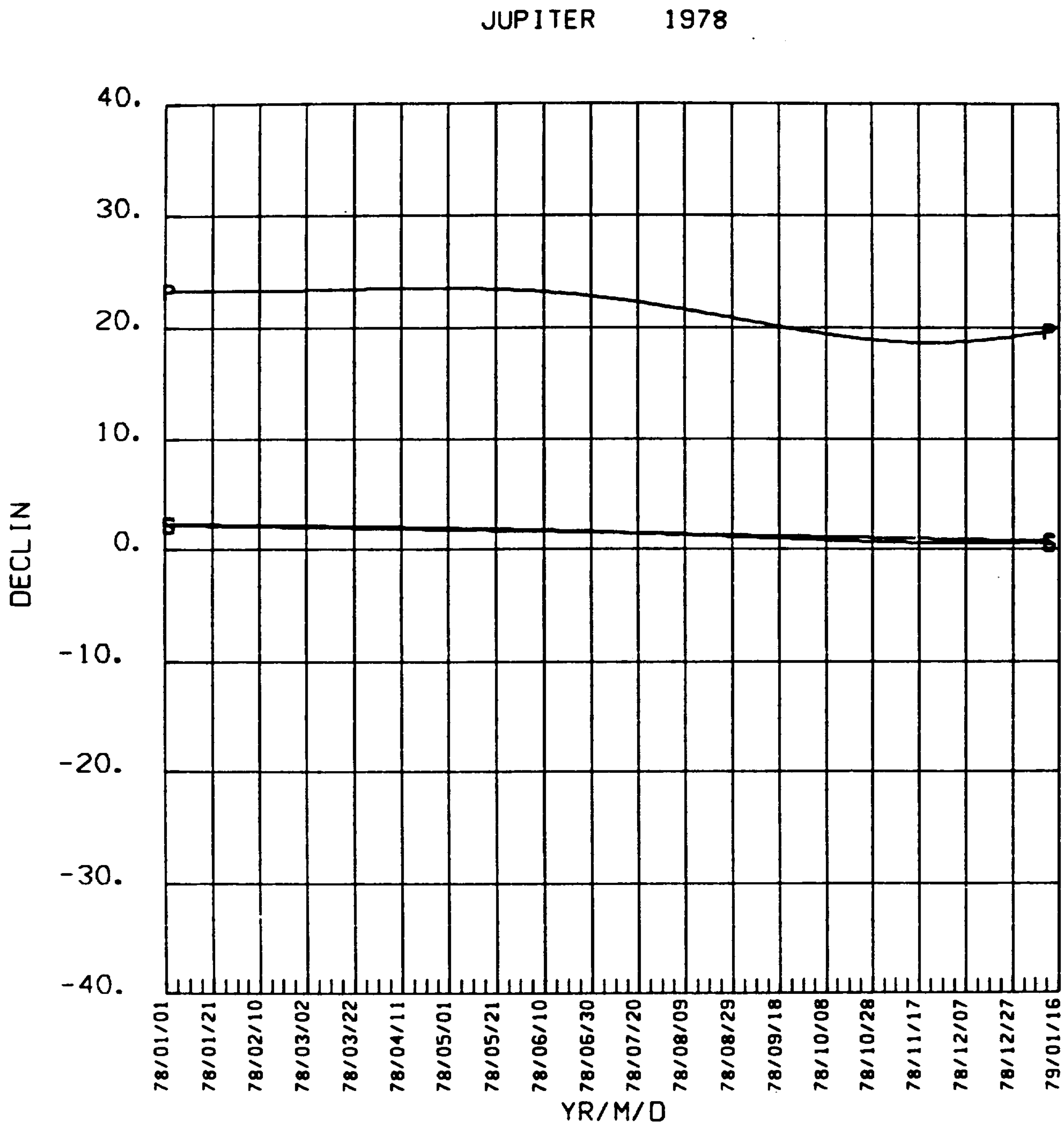
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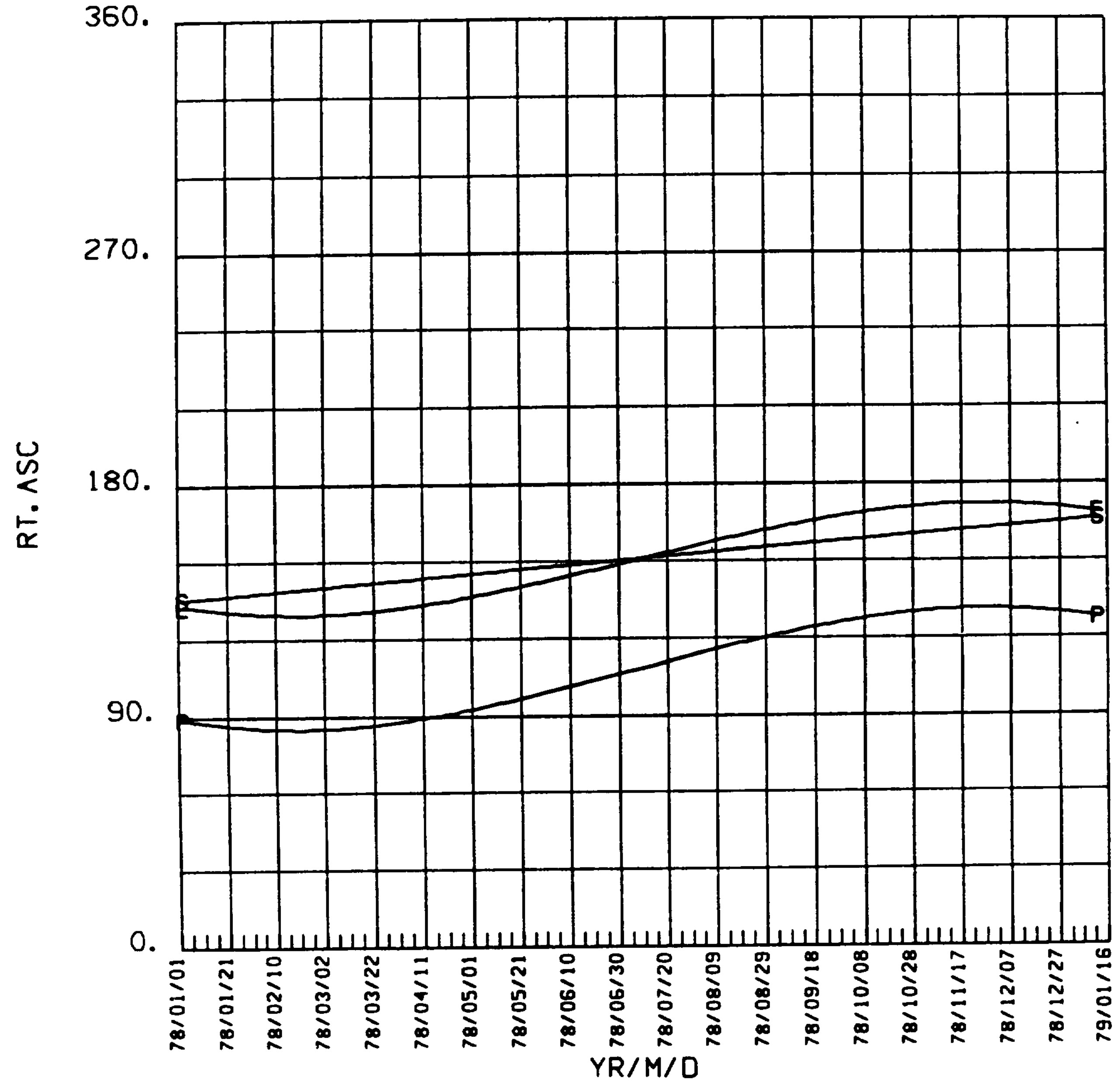

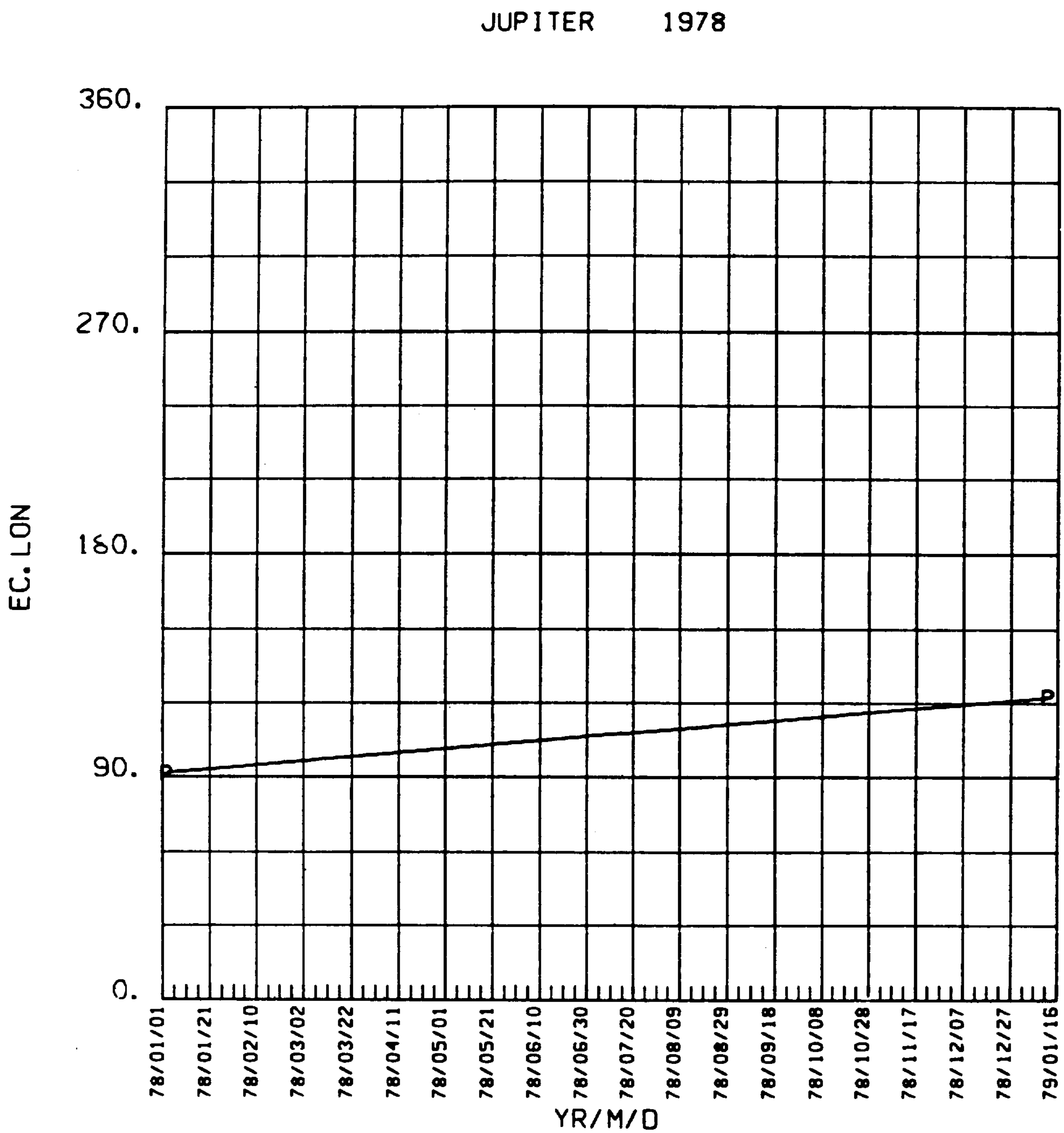

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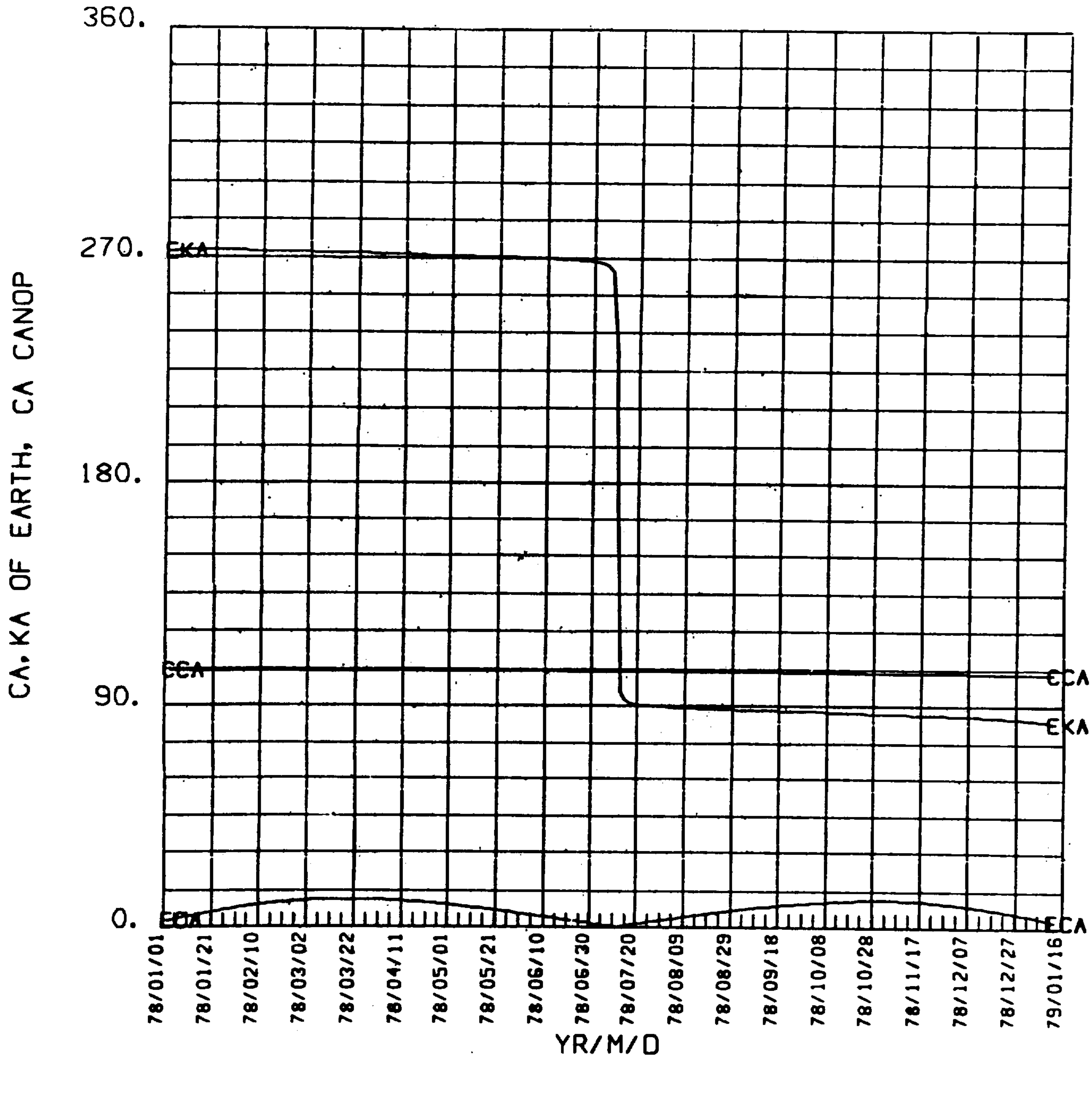

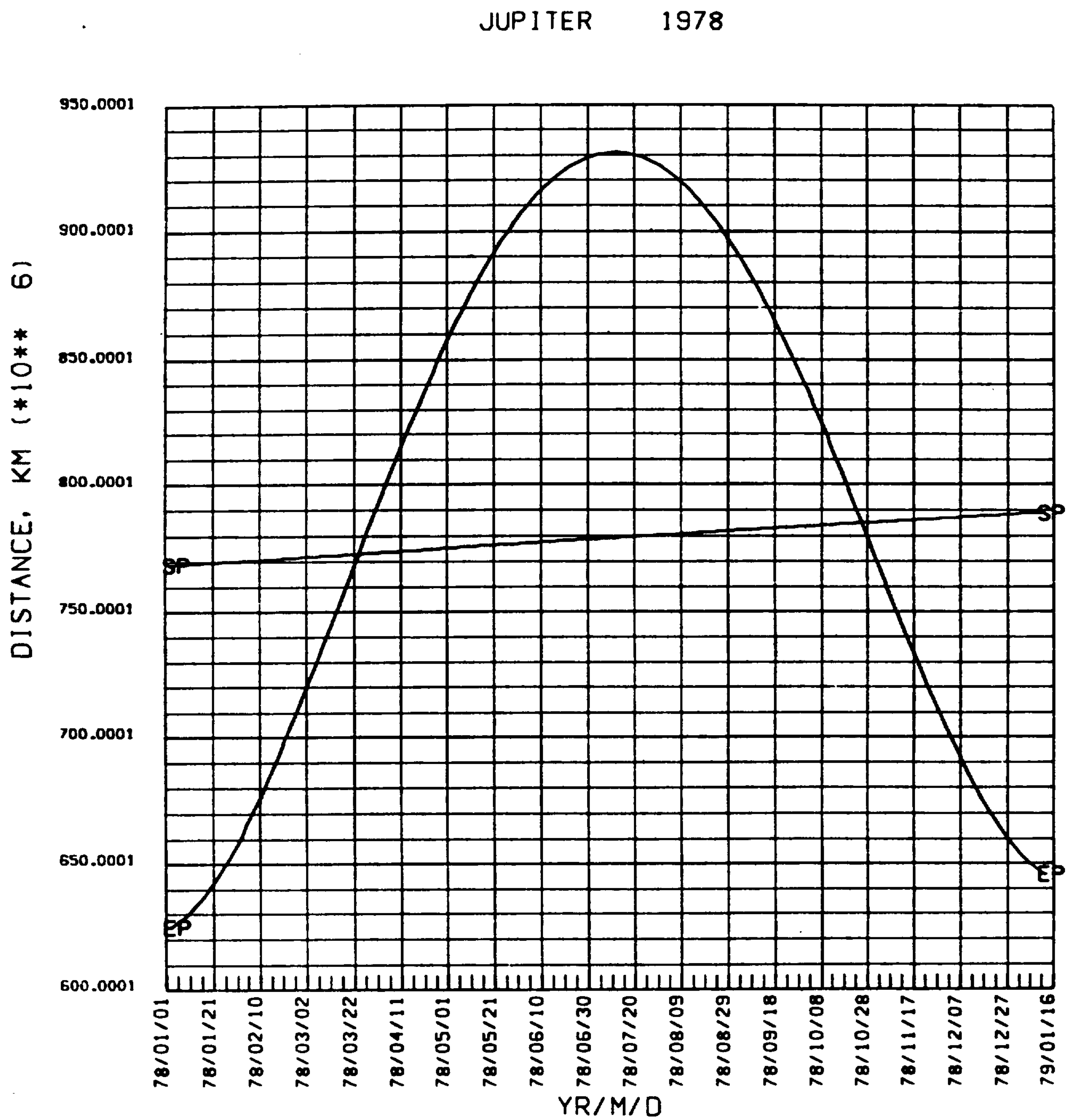
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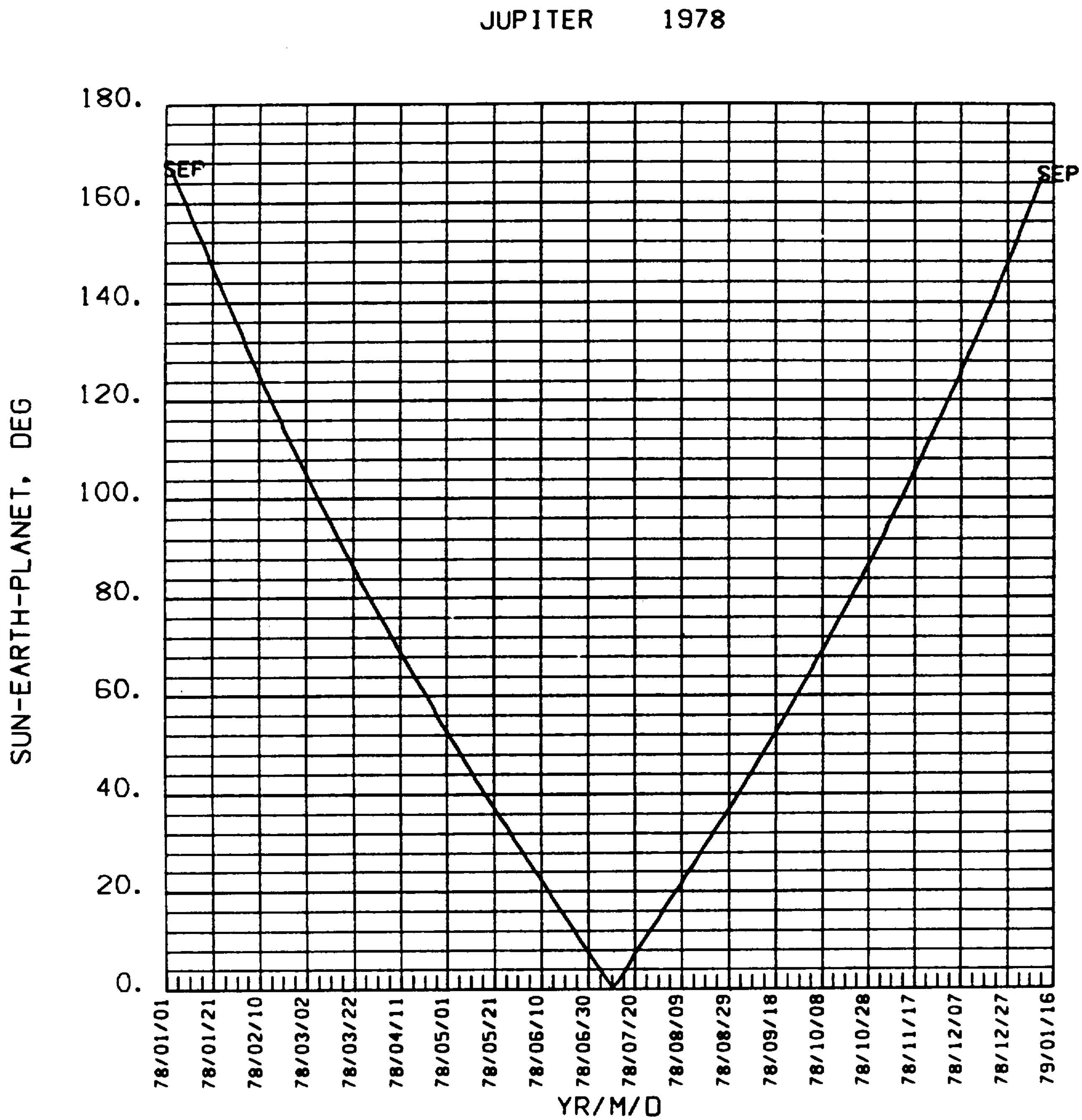
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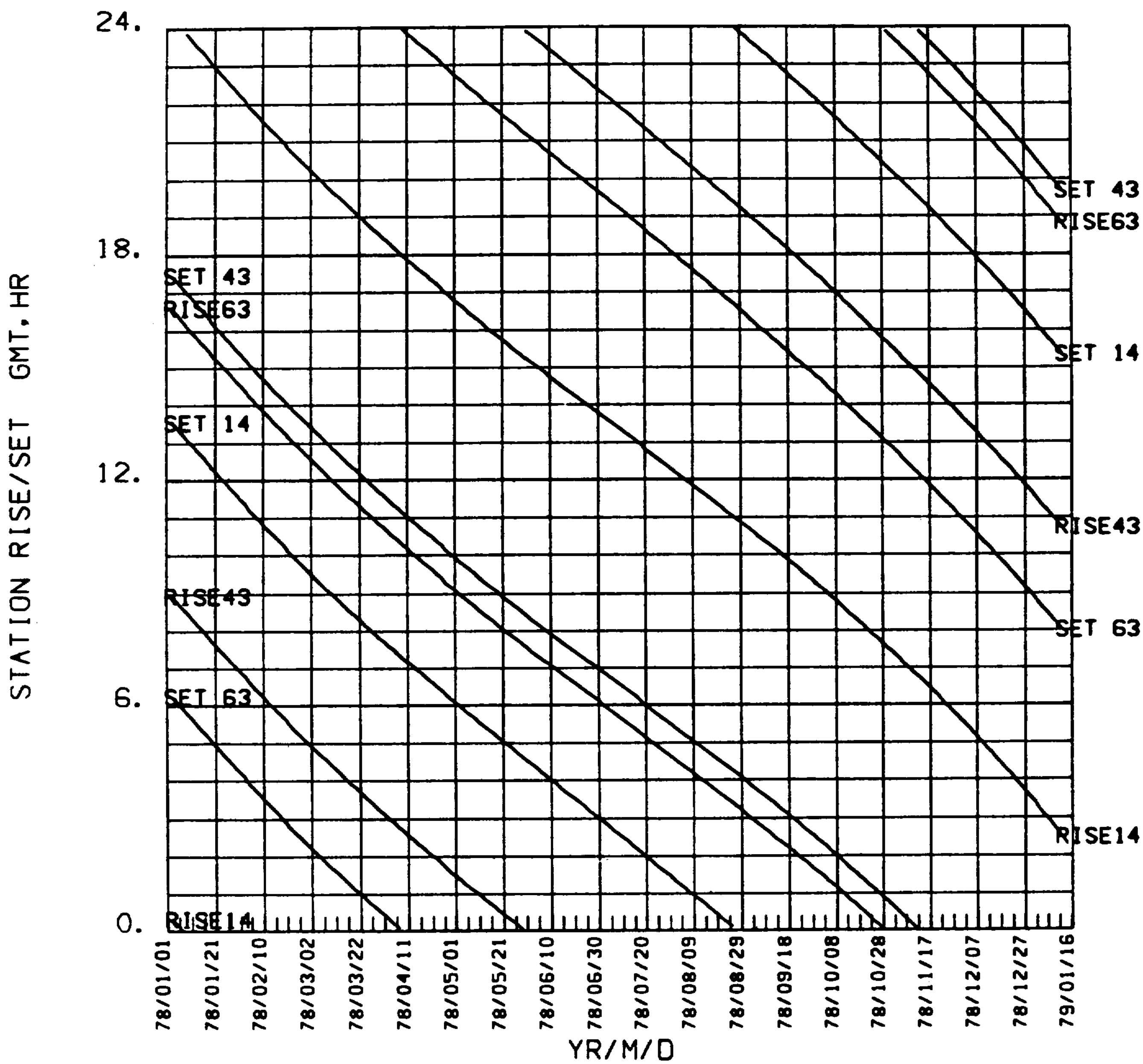

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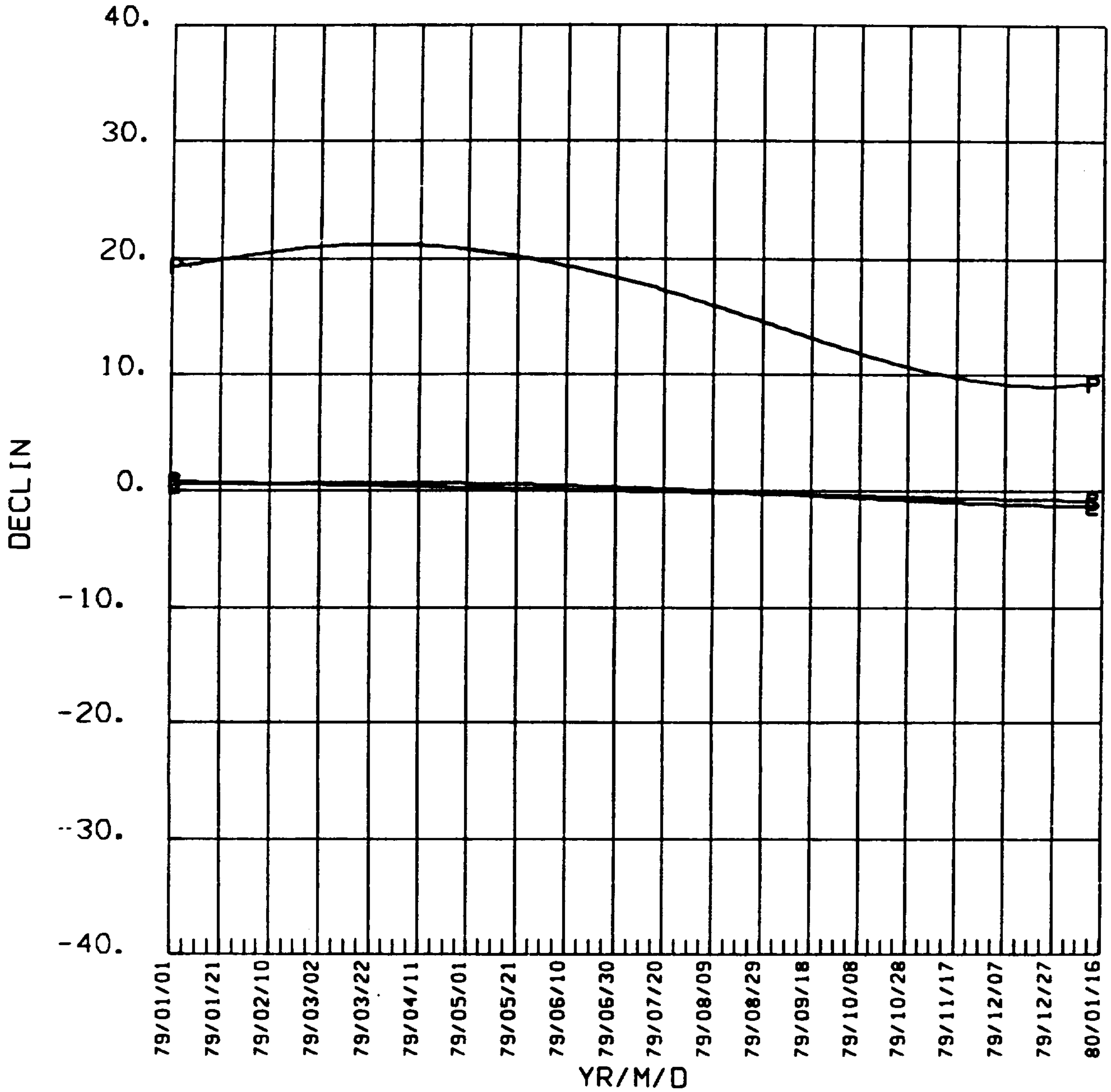

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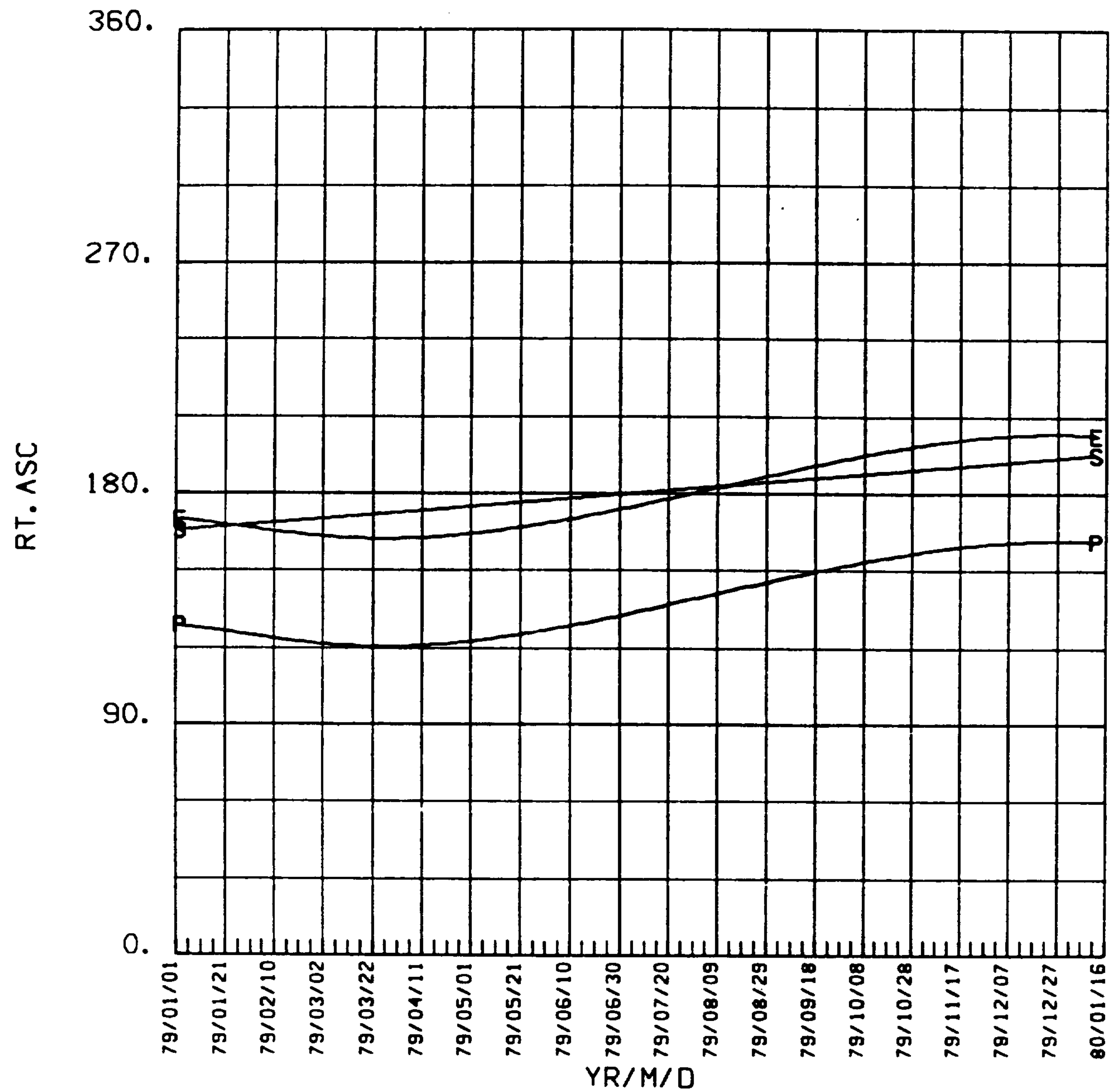

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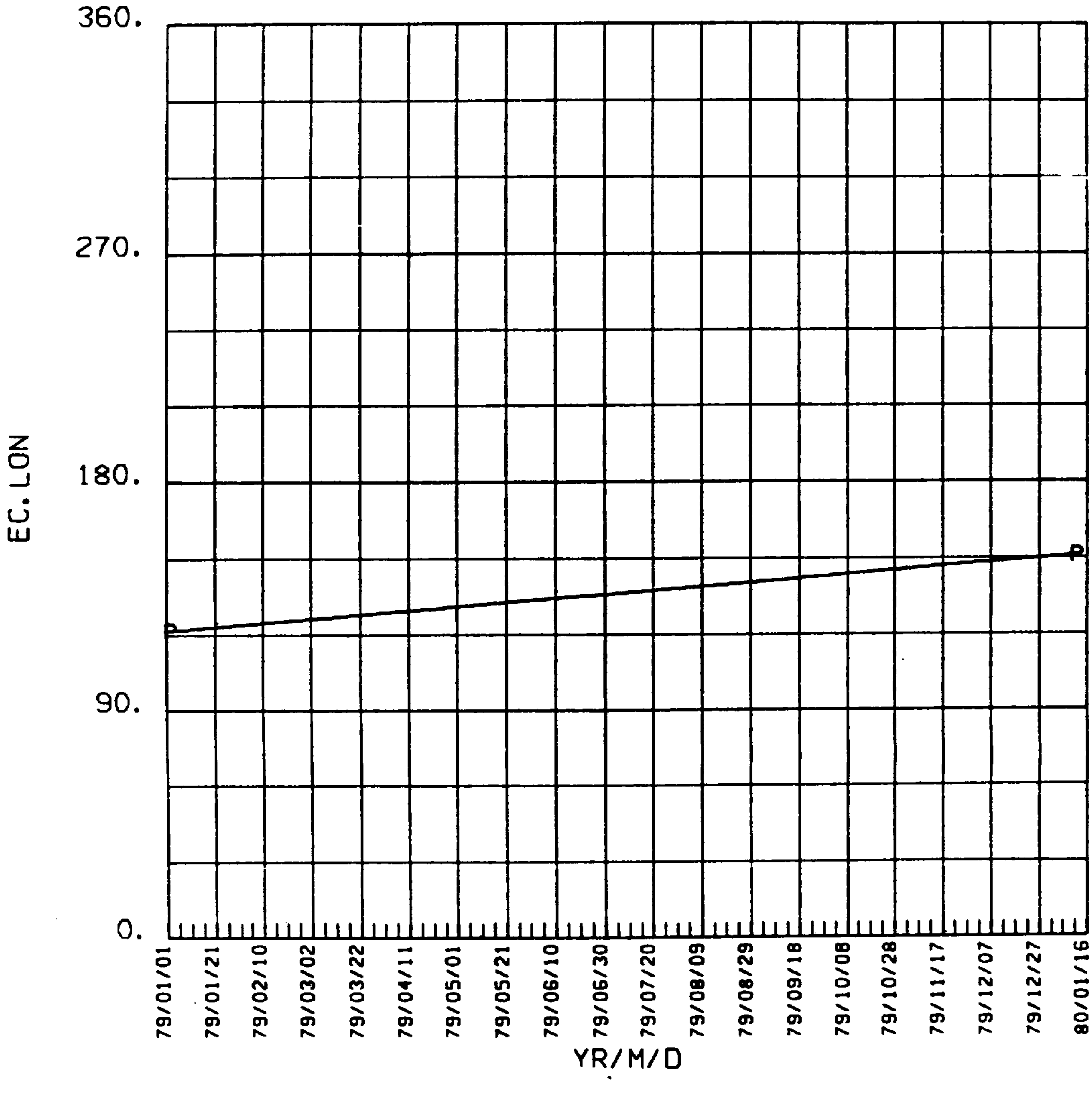

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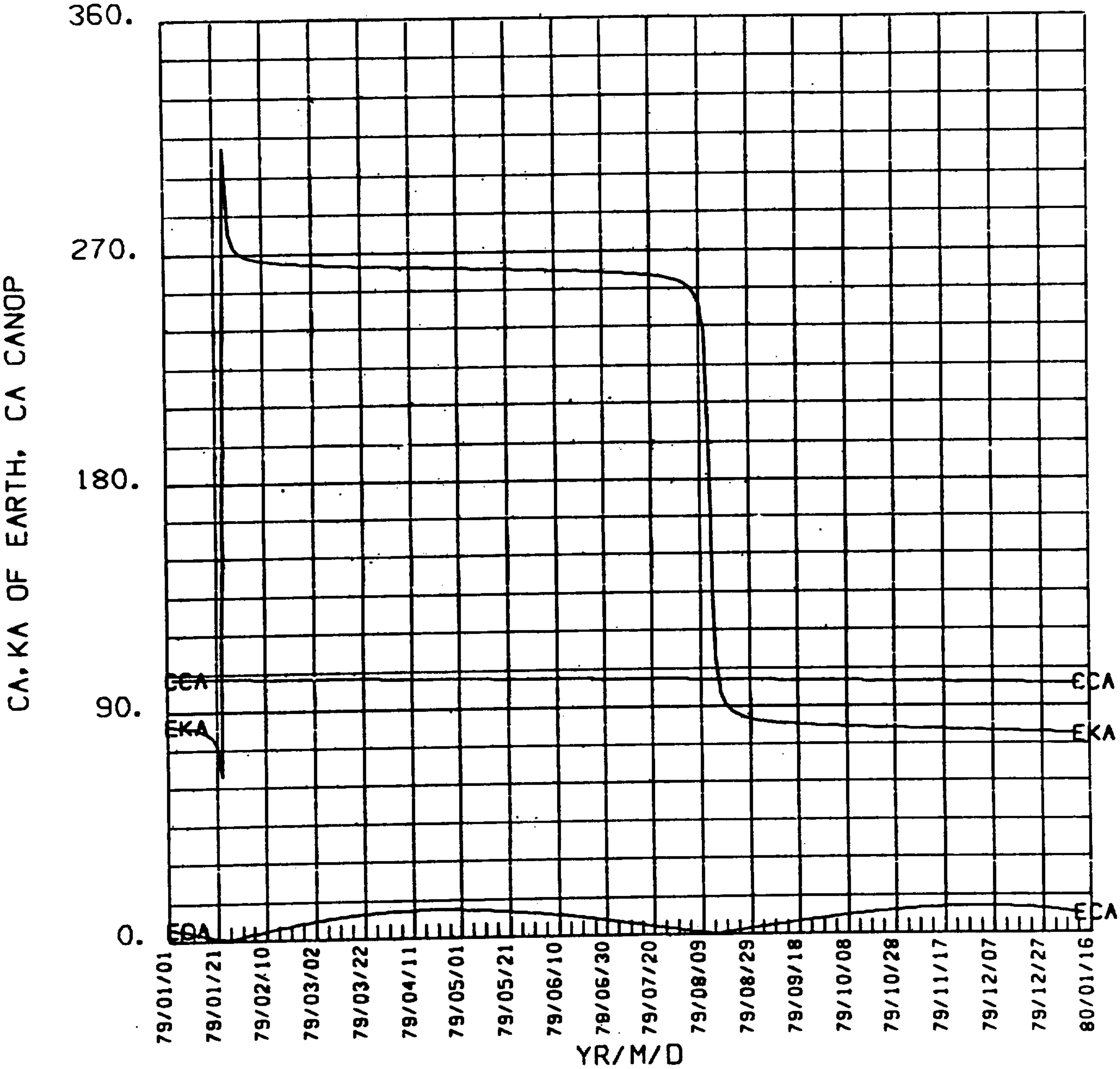

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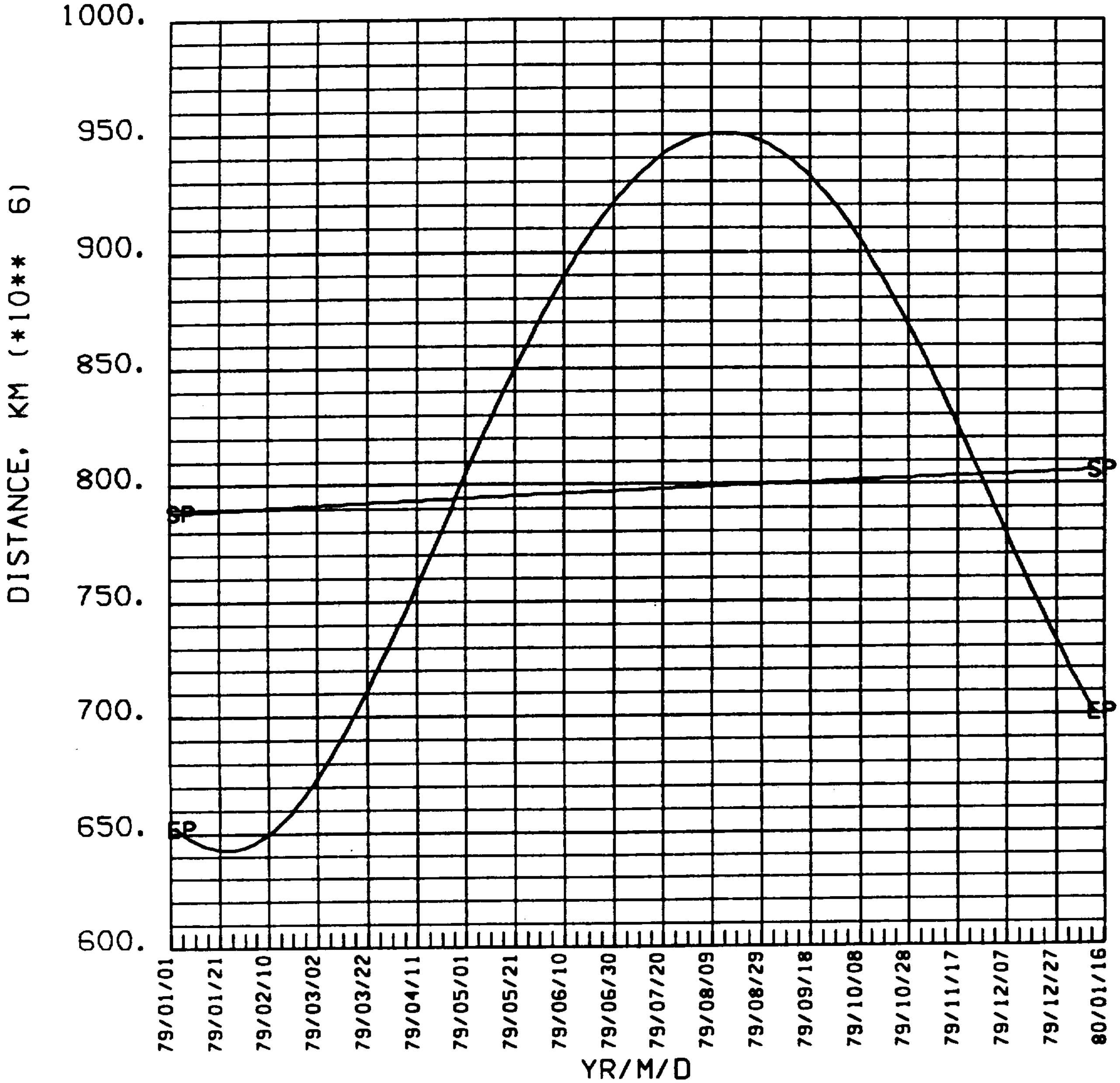

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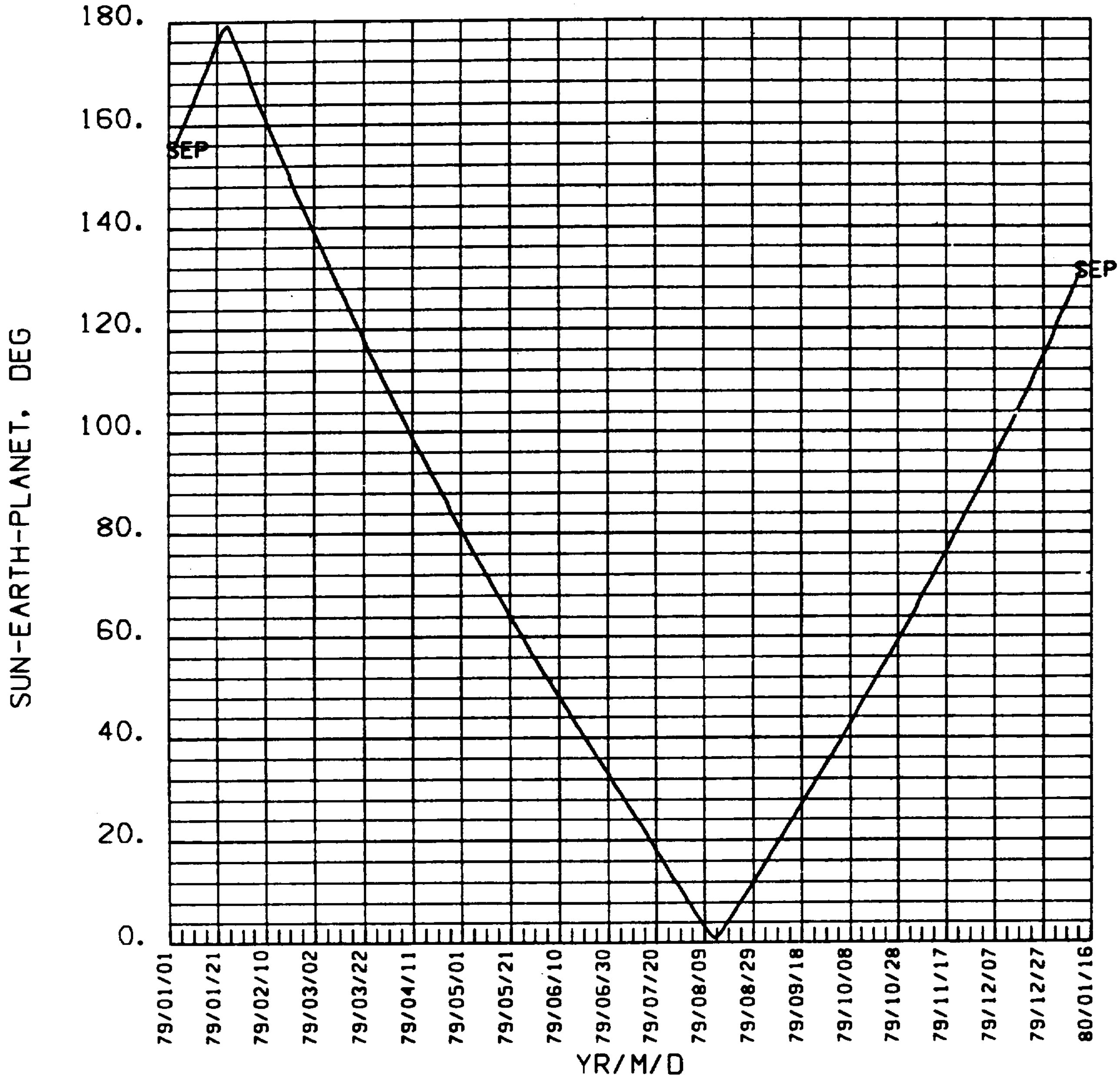

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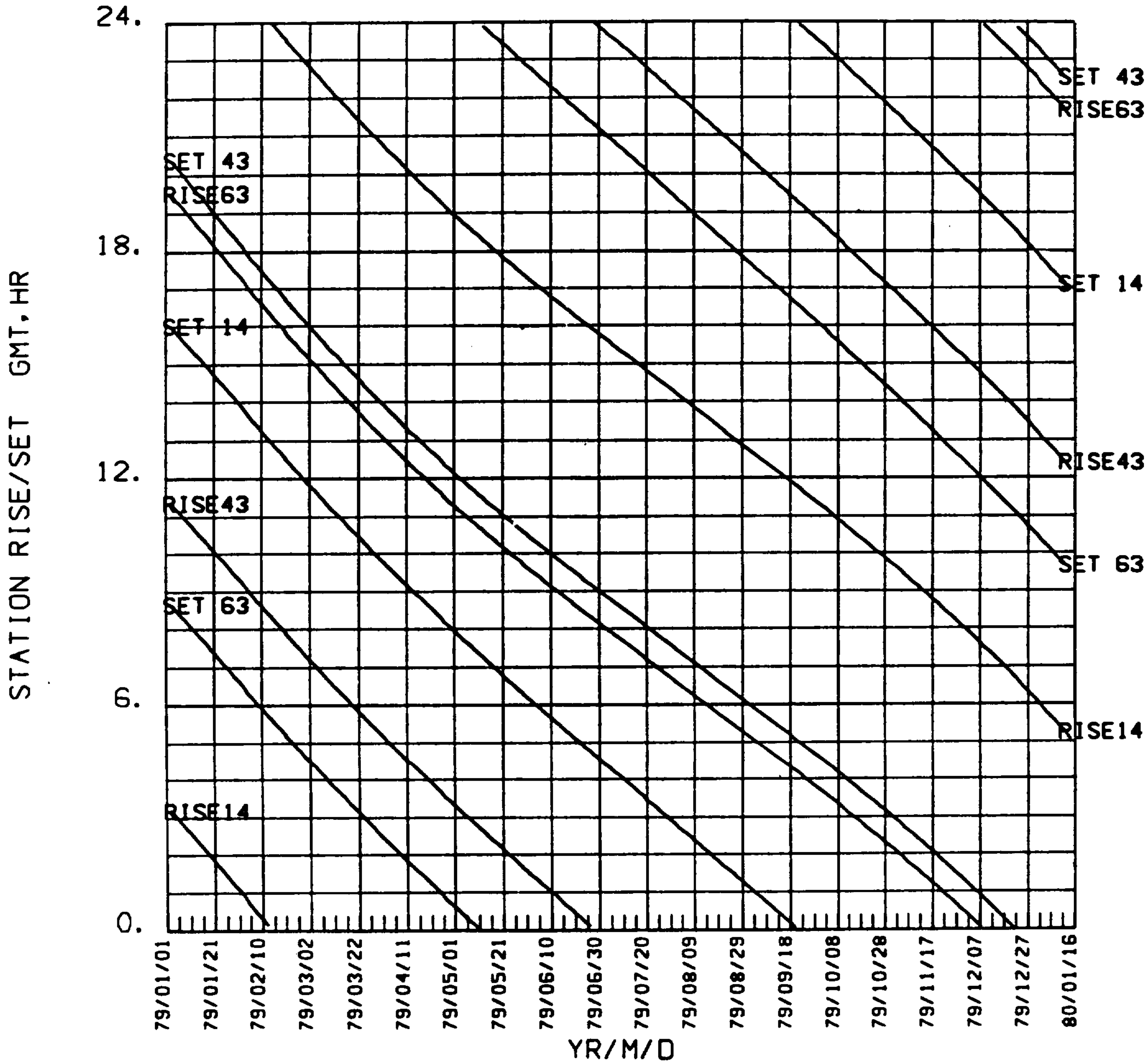
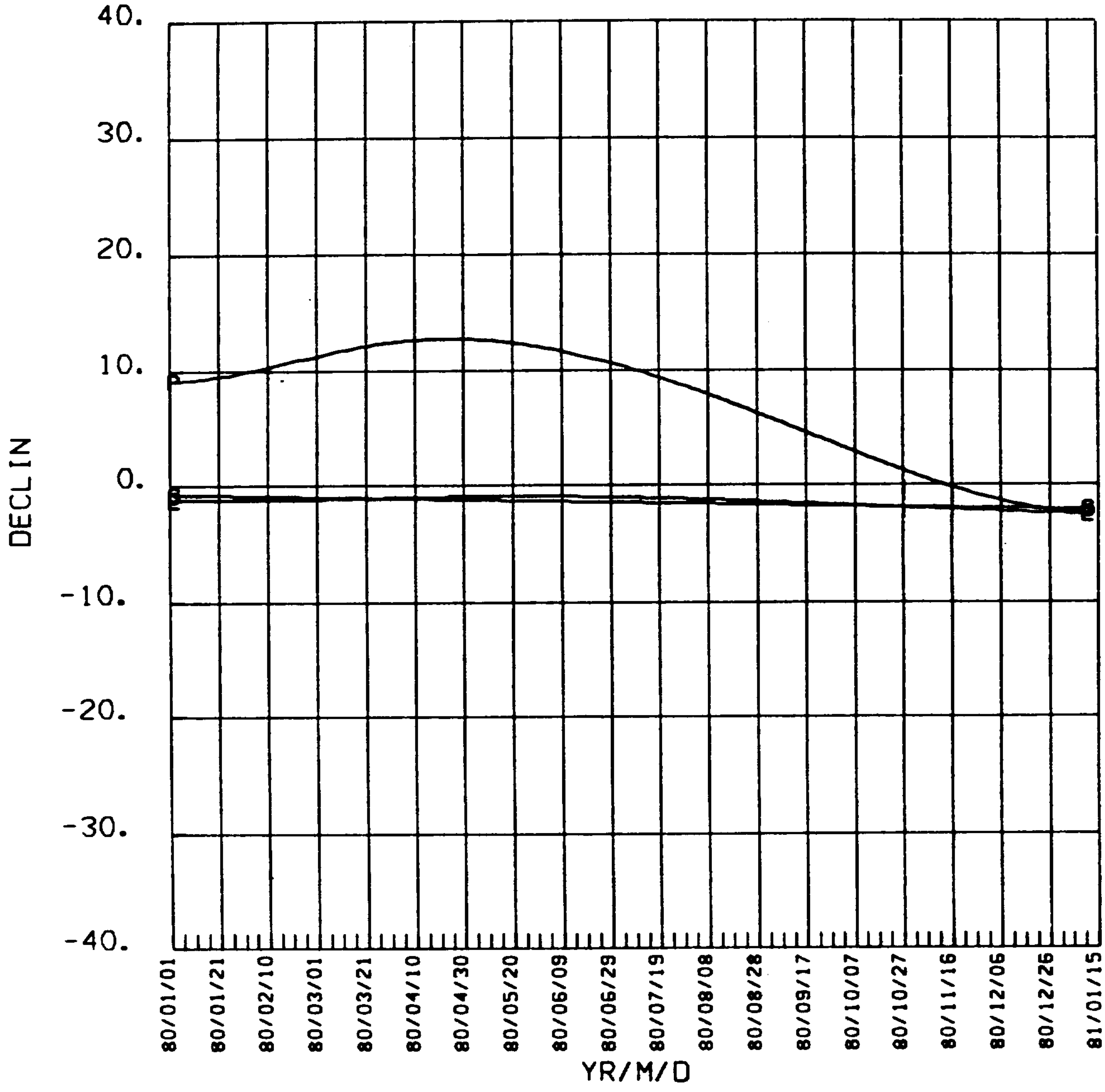
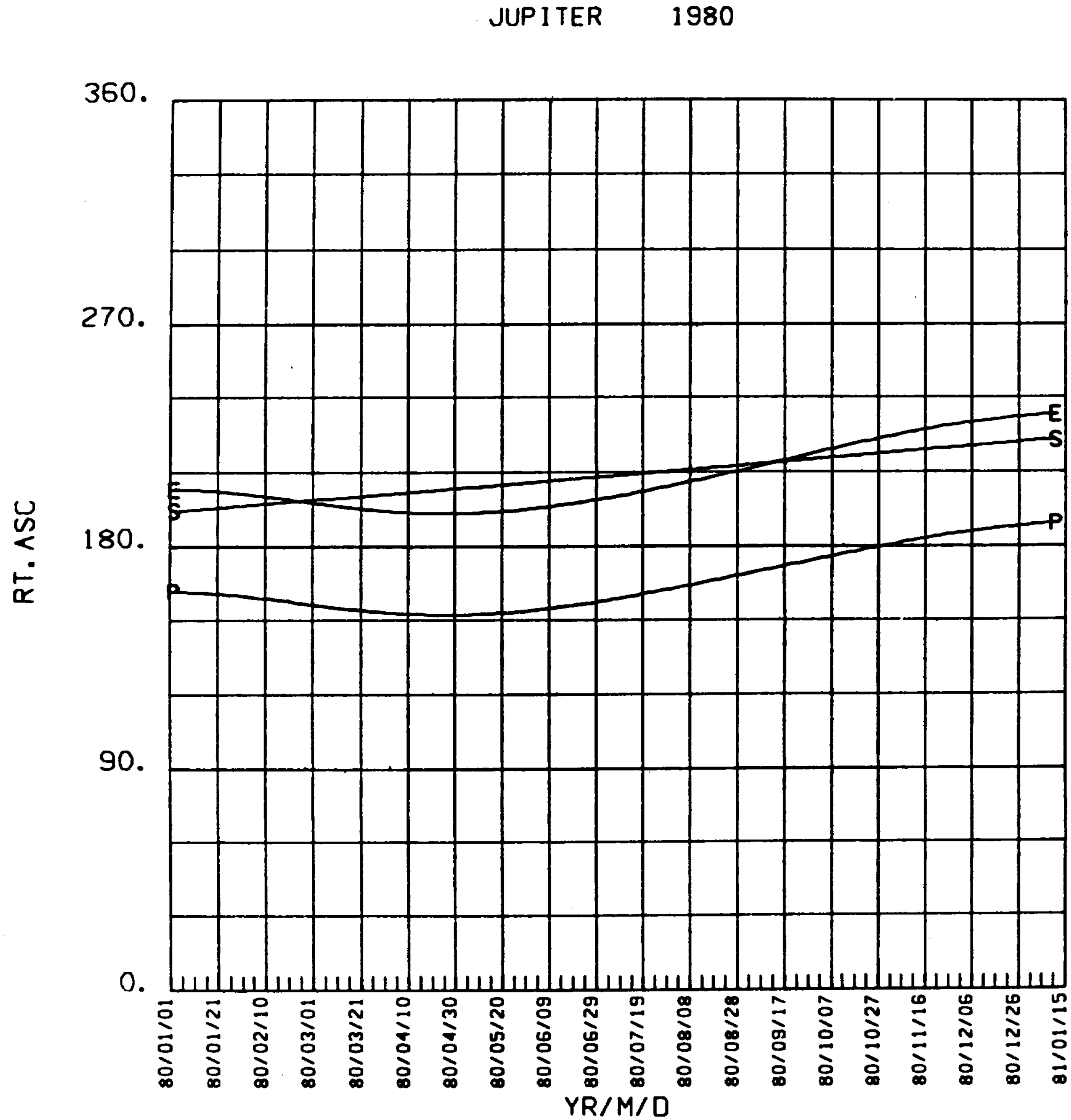


JUPITER 1980





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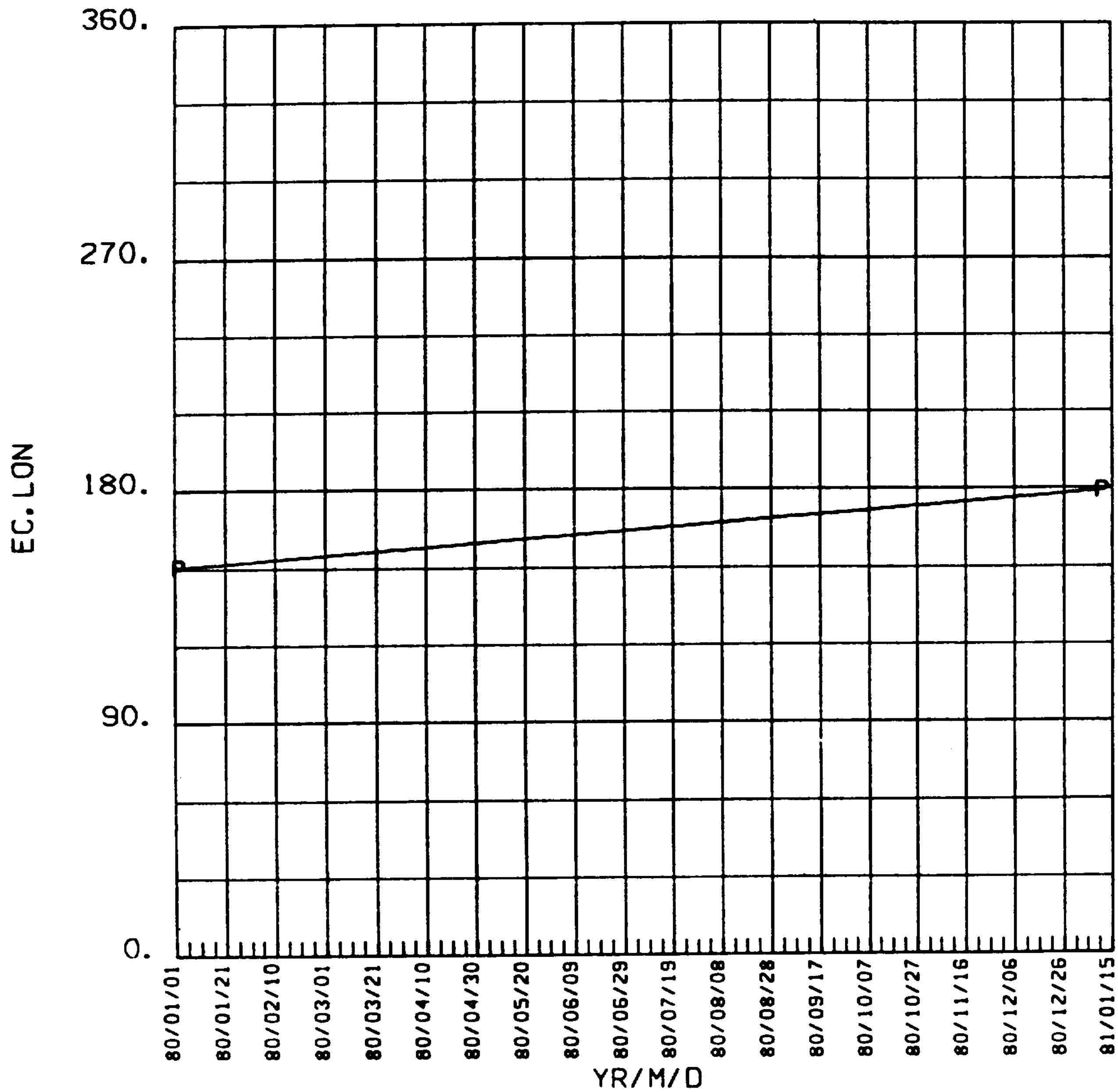

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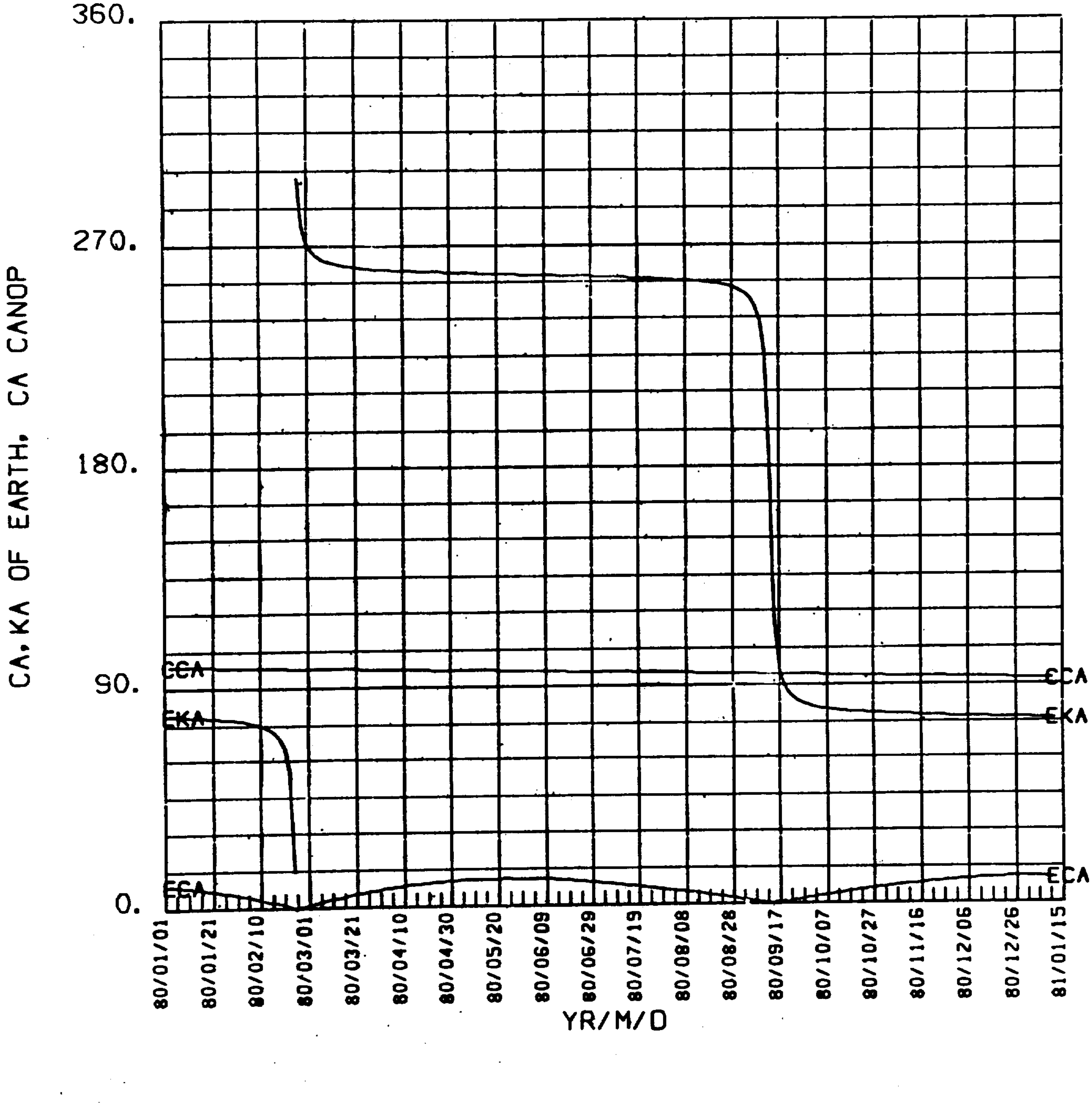

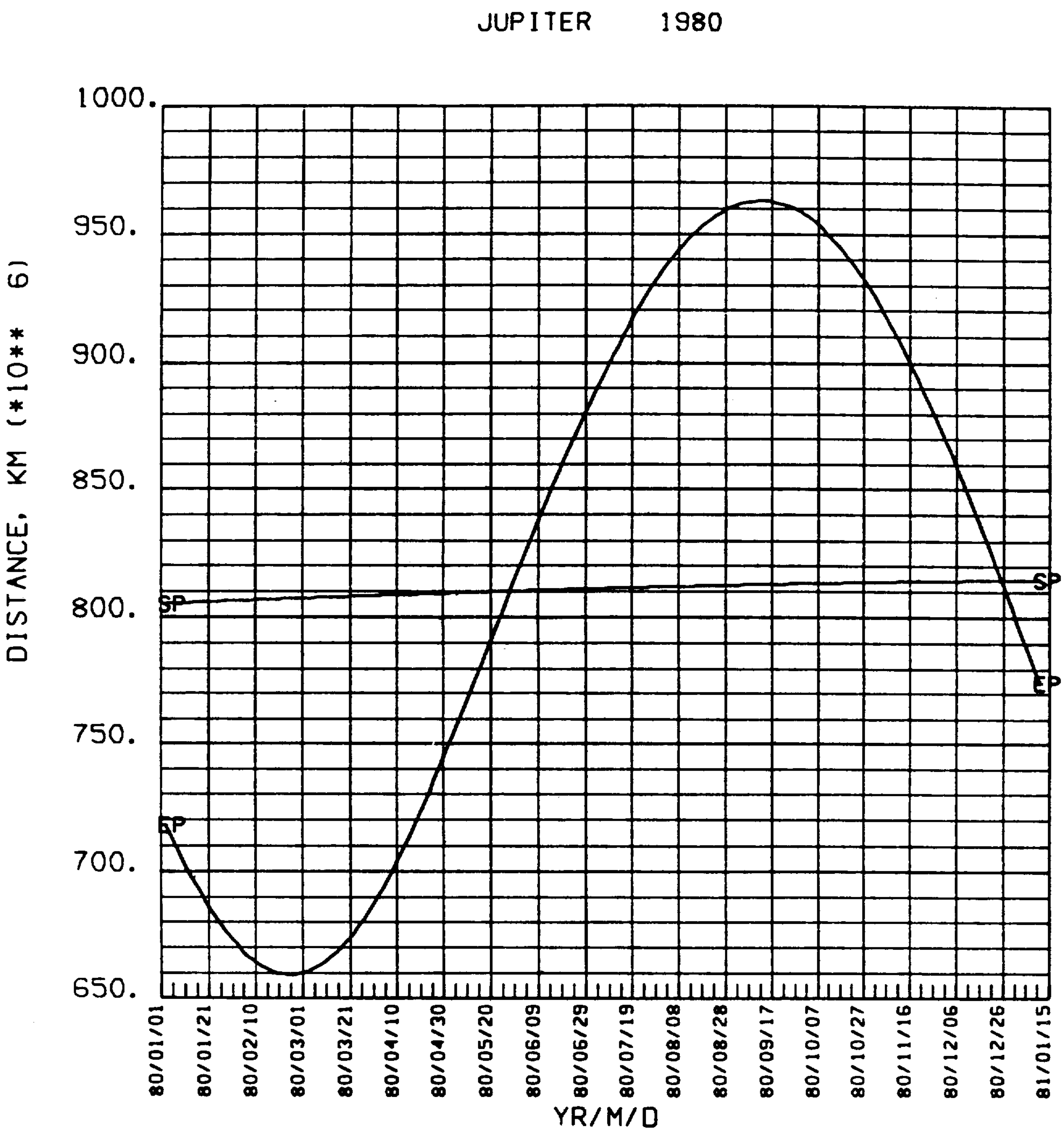
JUPITER 1980
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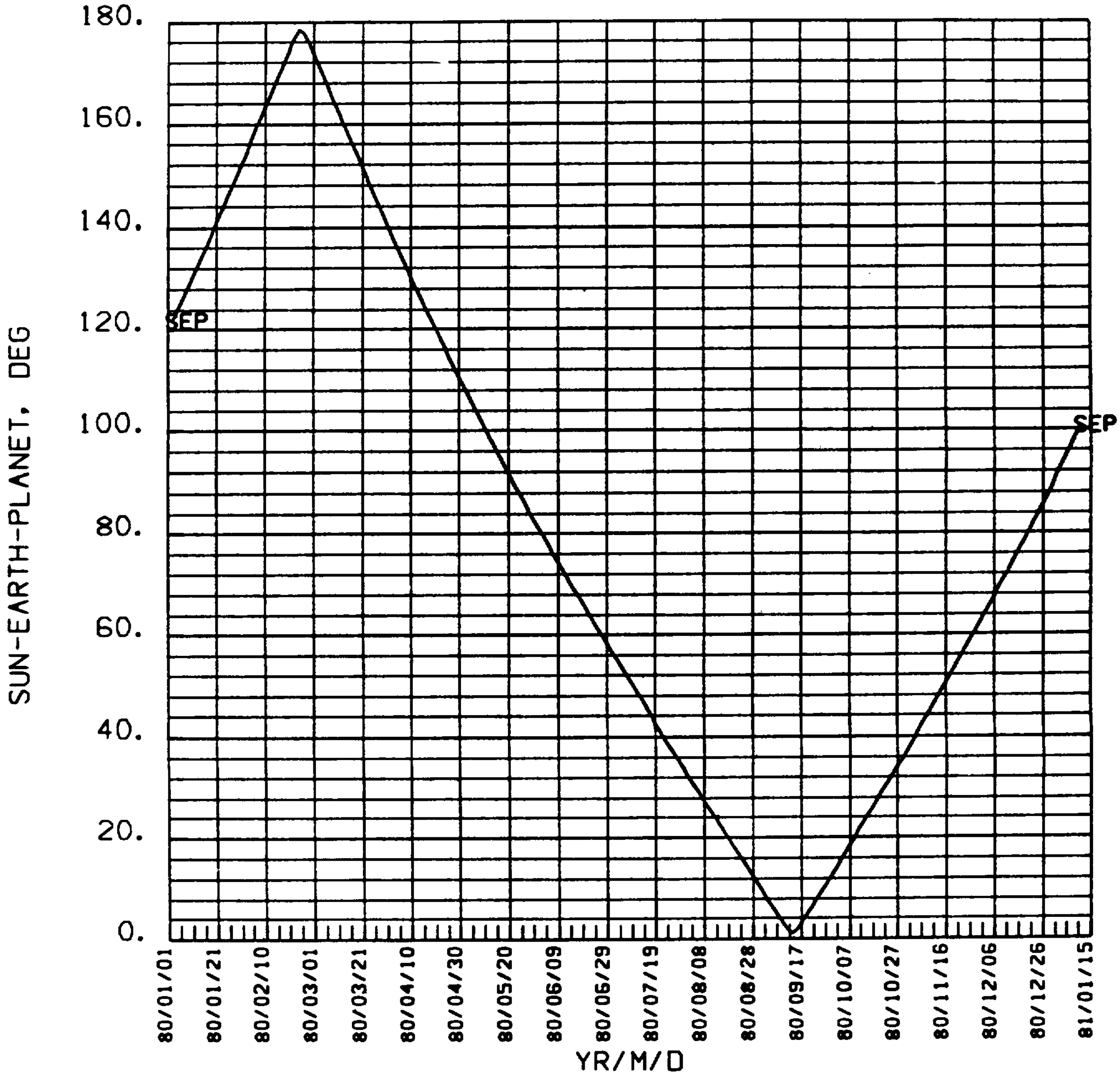

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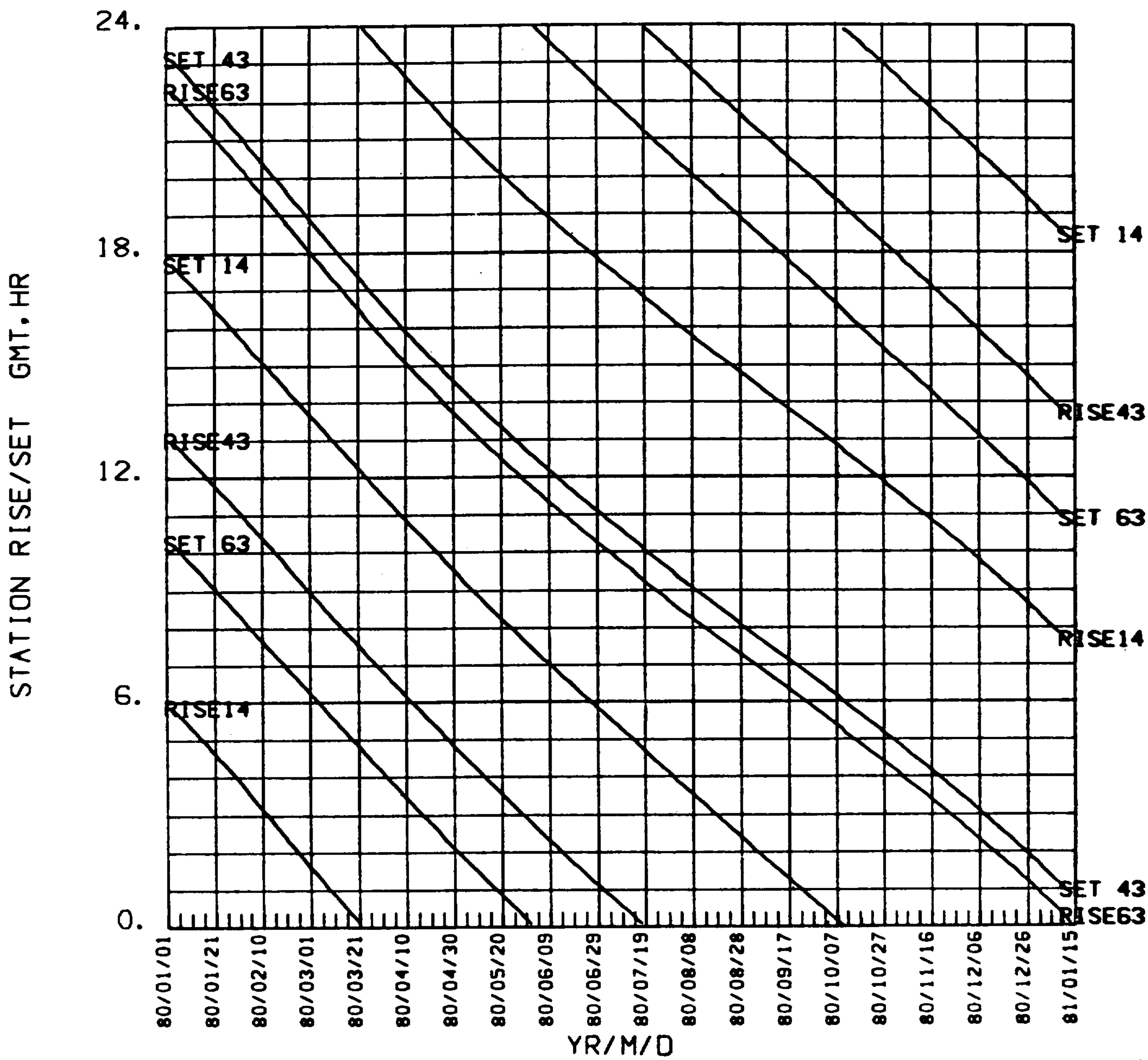

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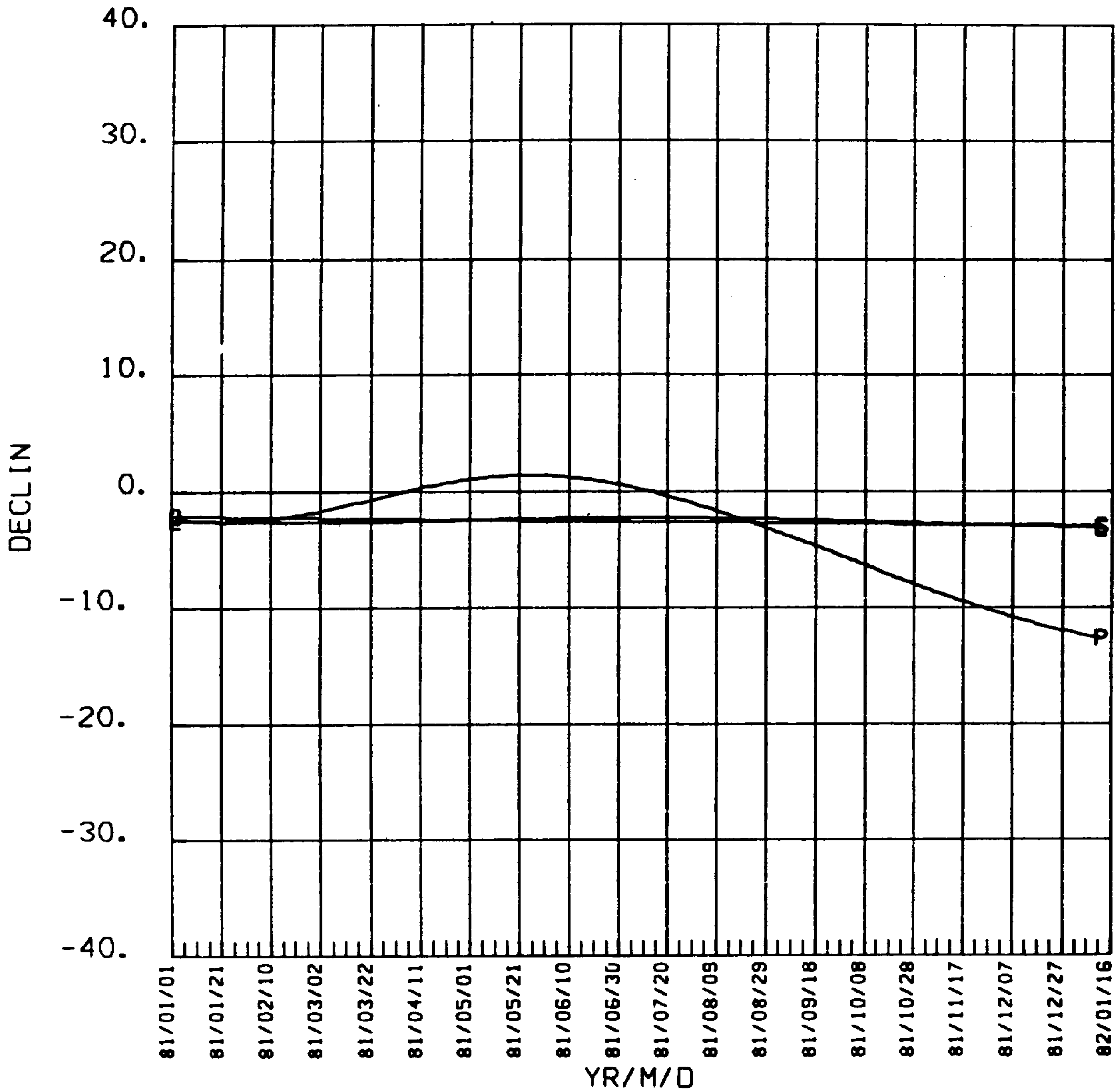

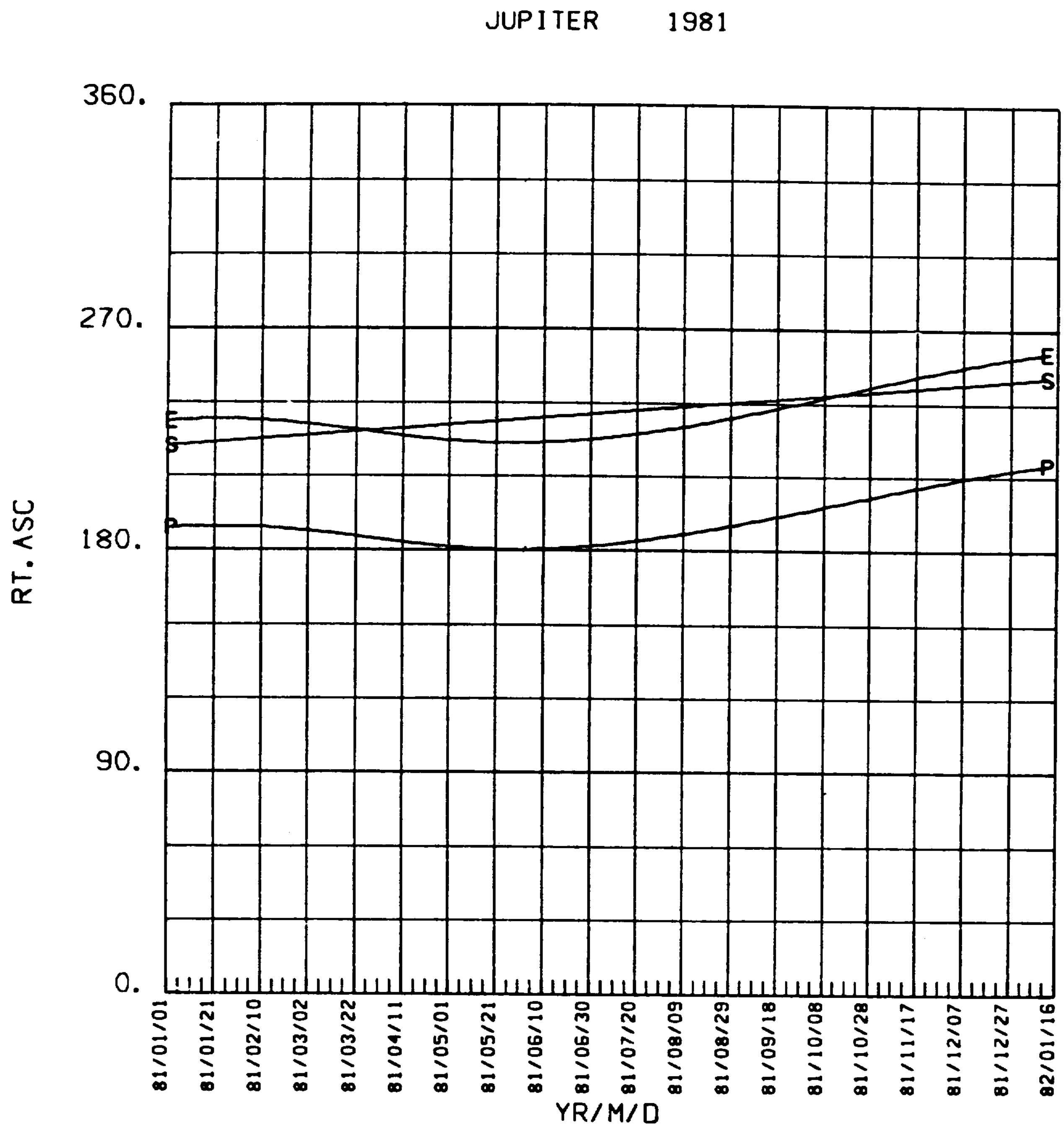

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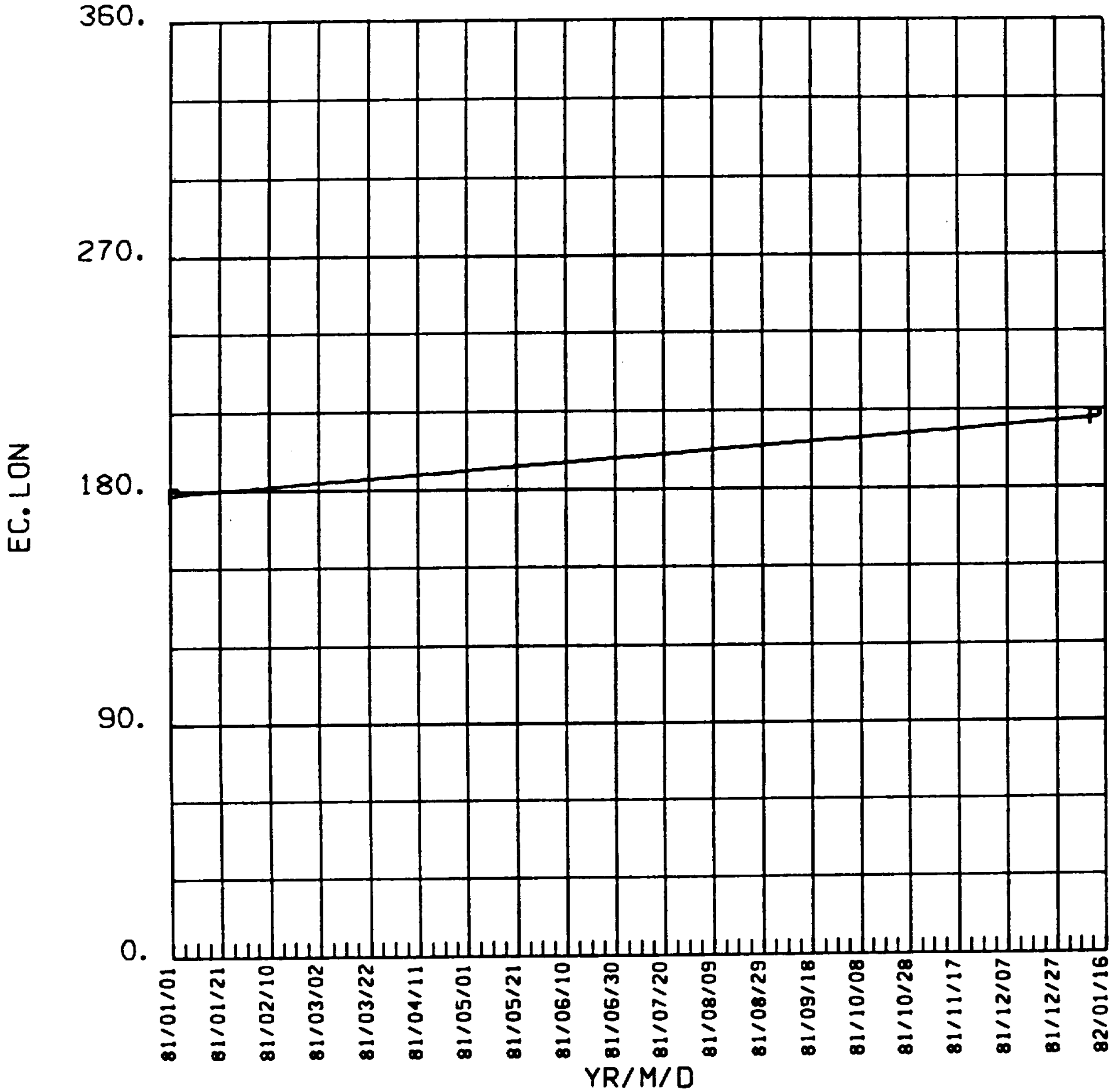

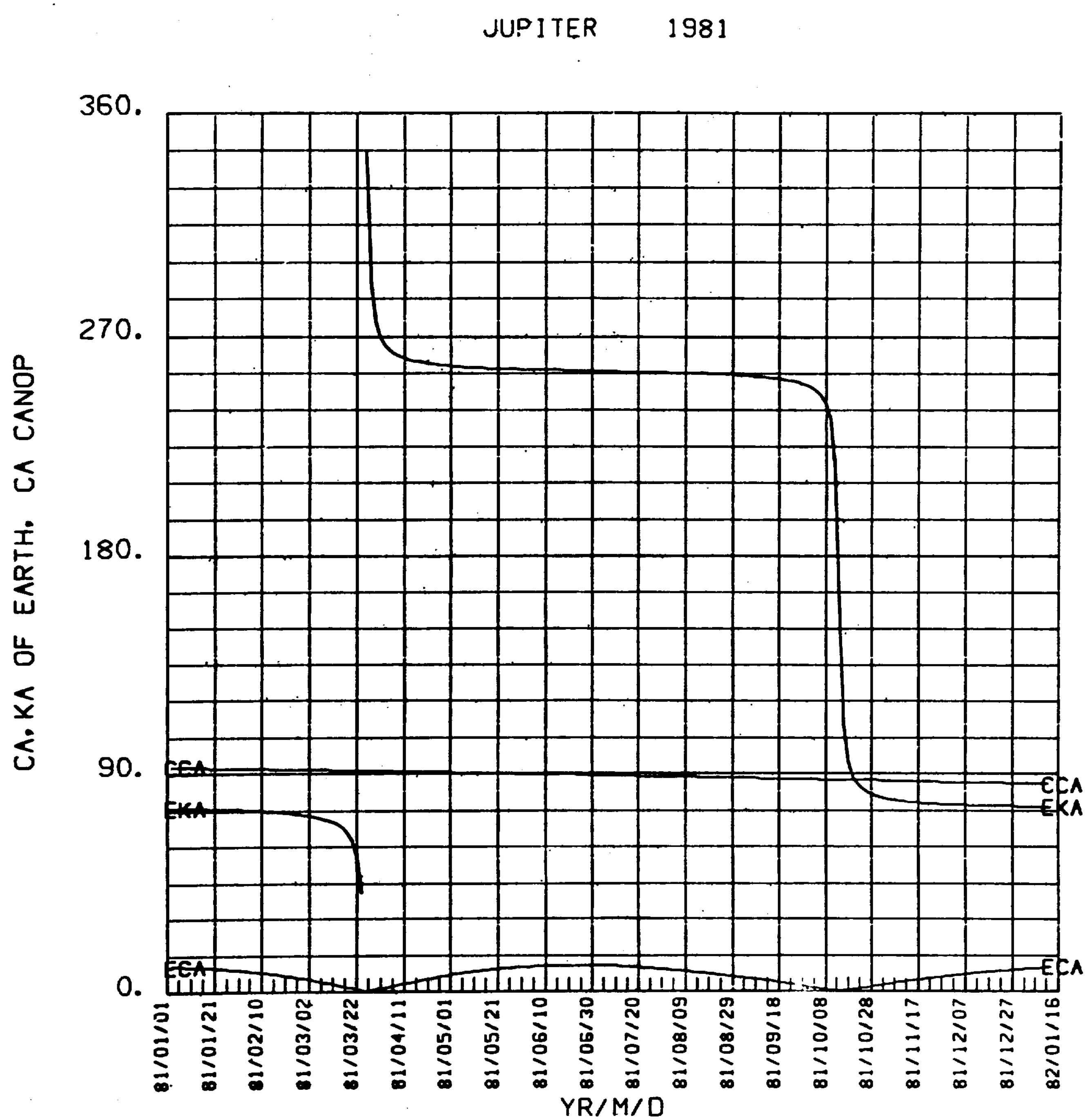
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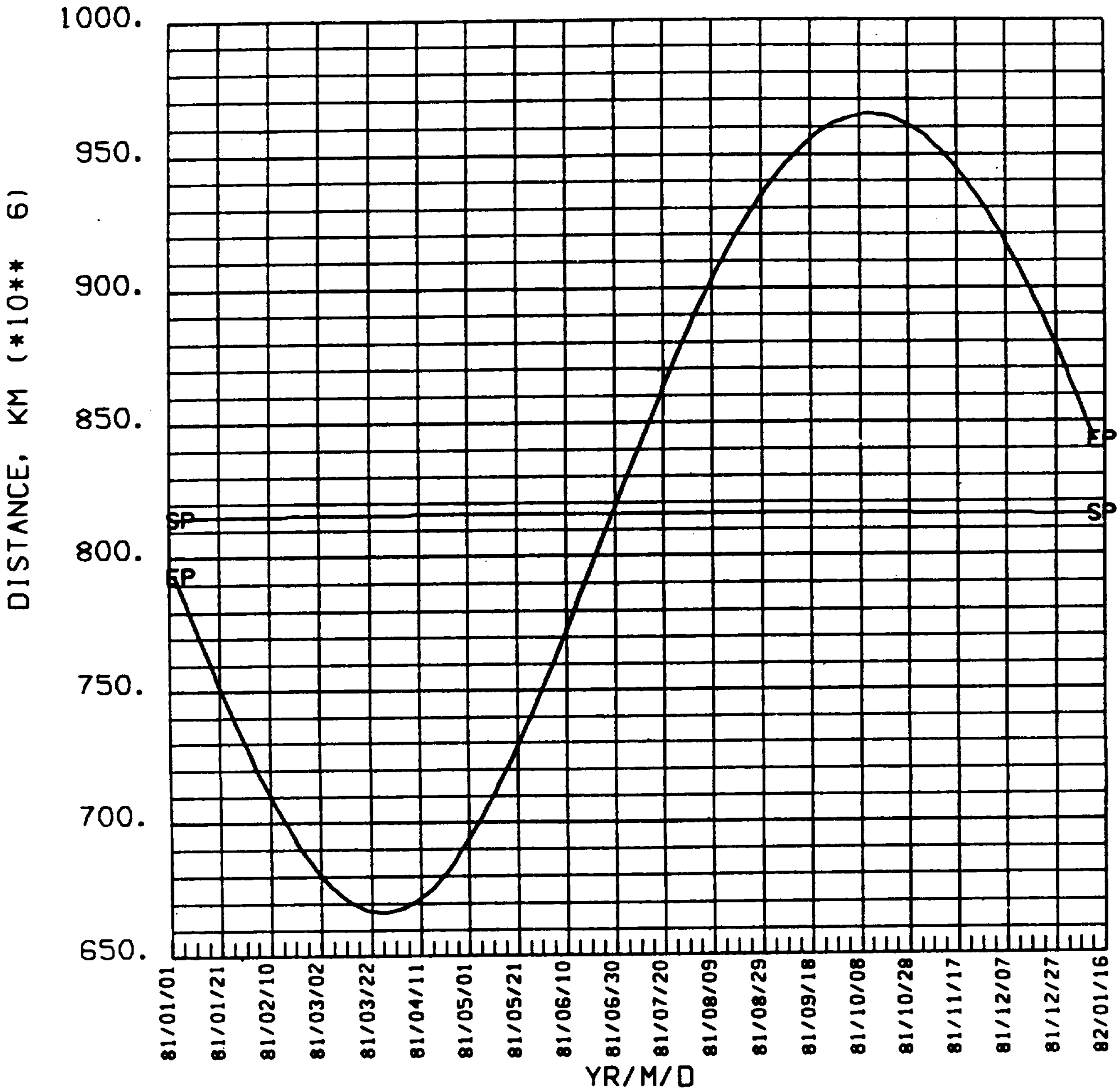

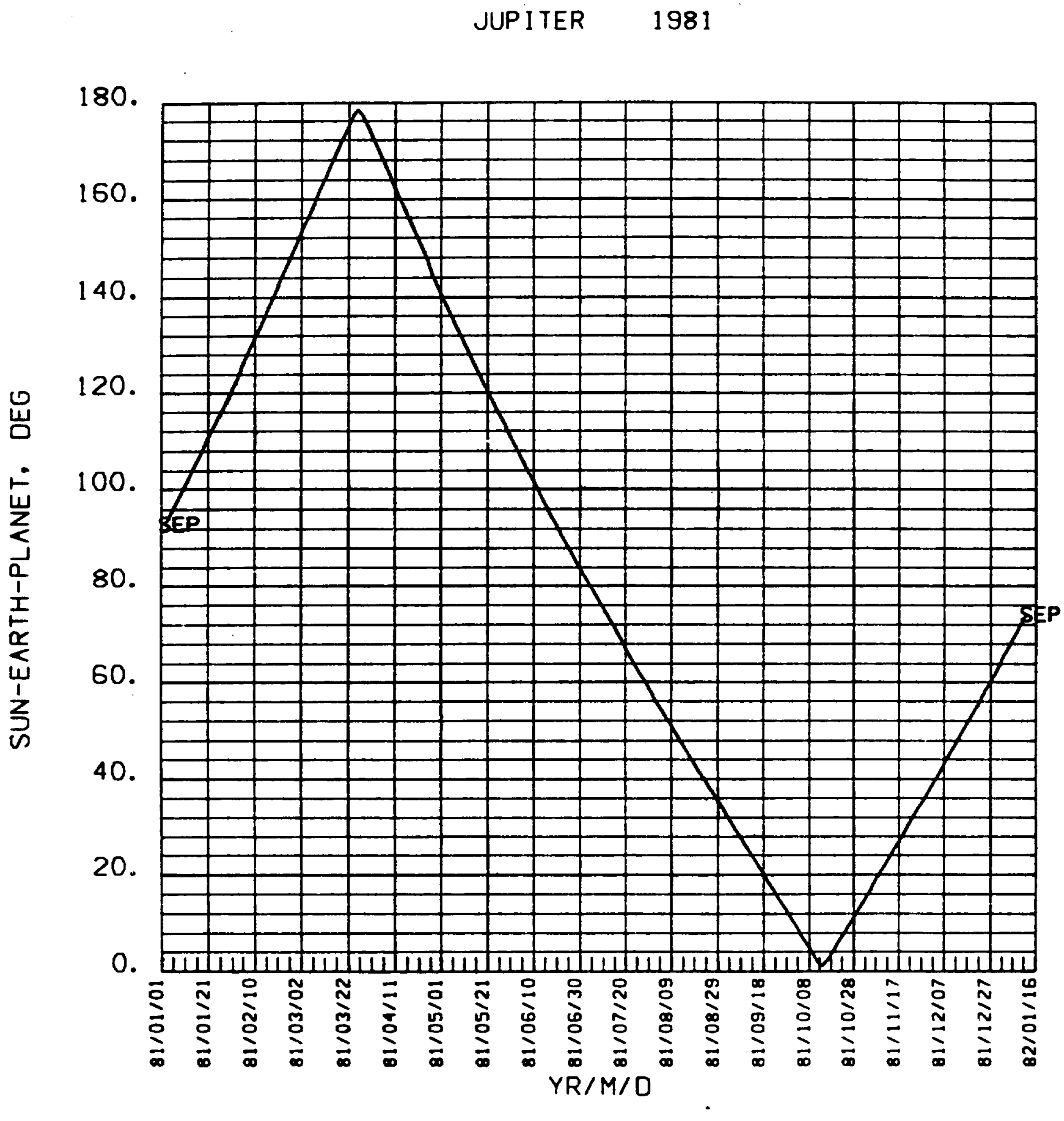
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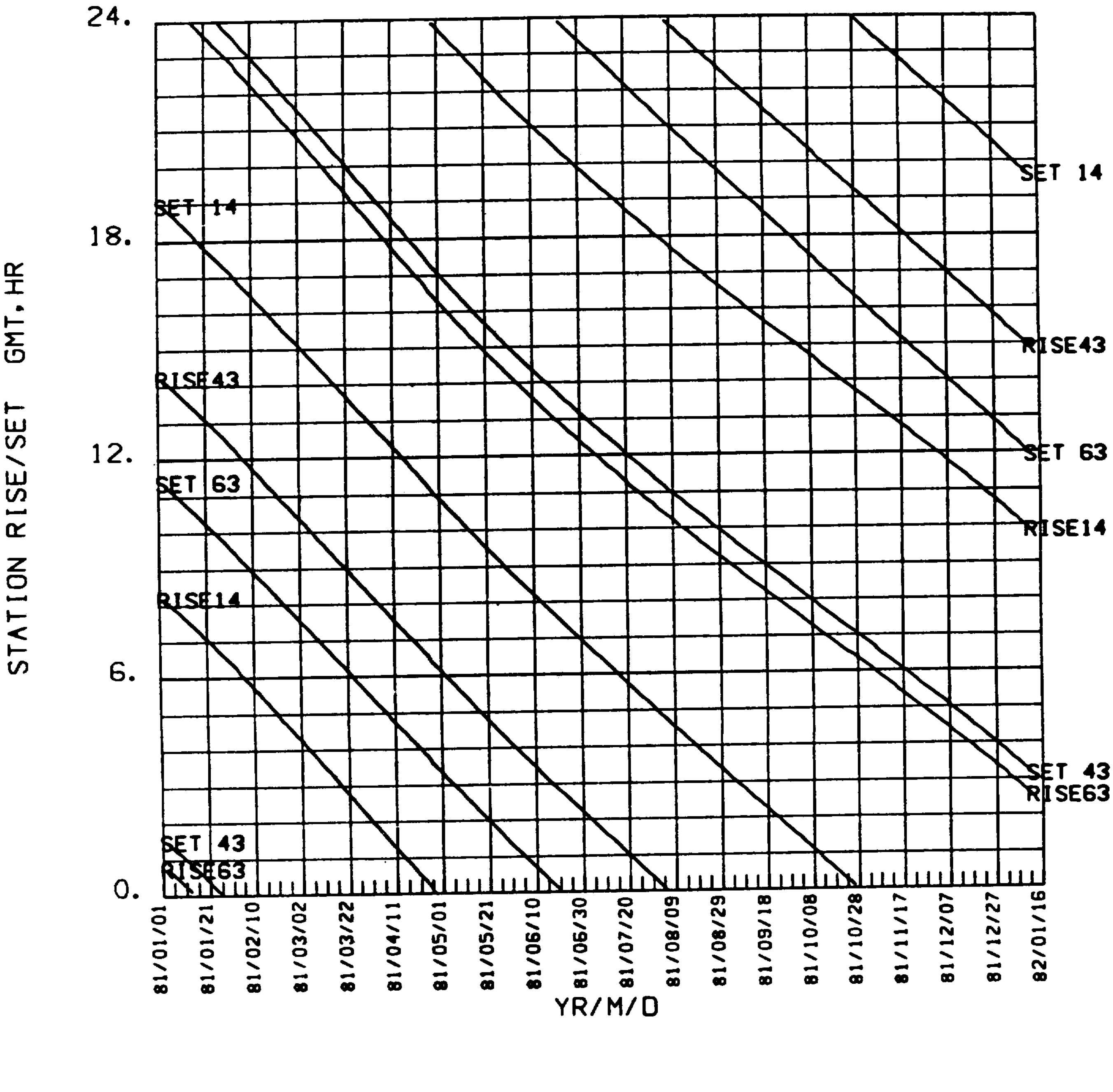

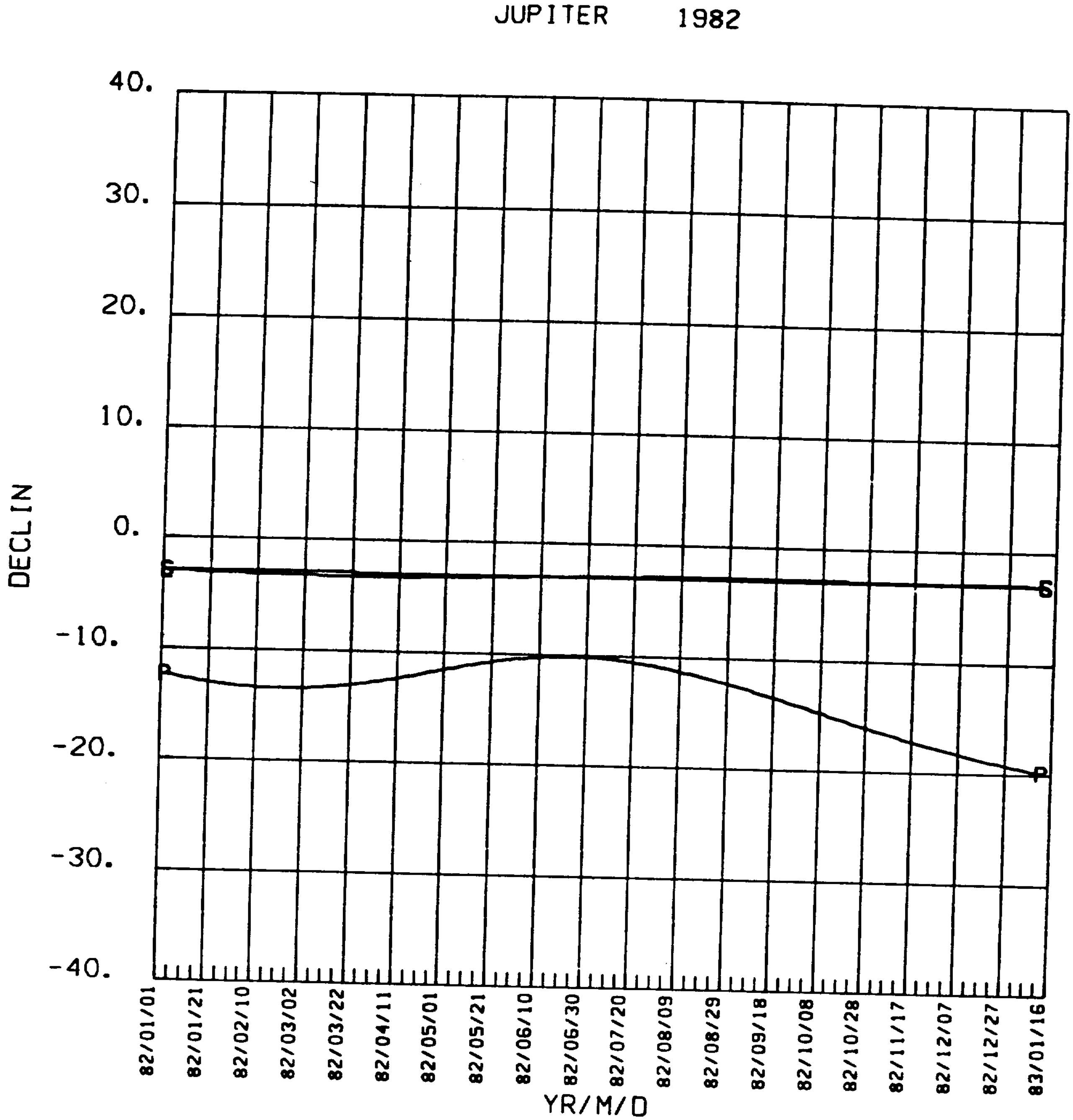
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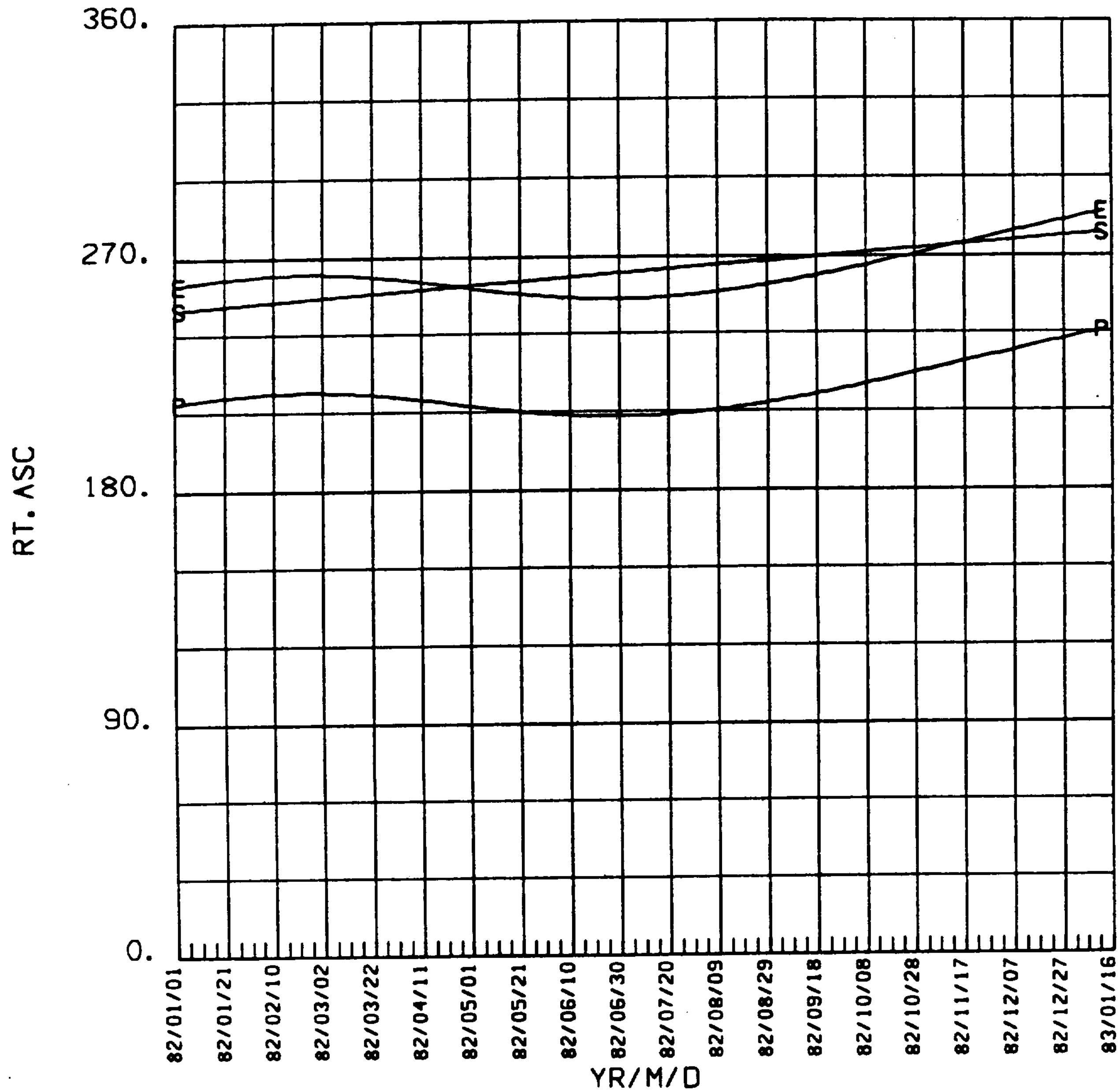

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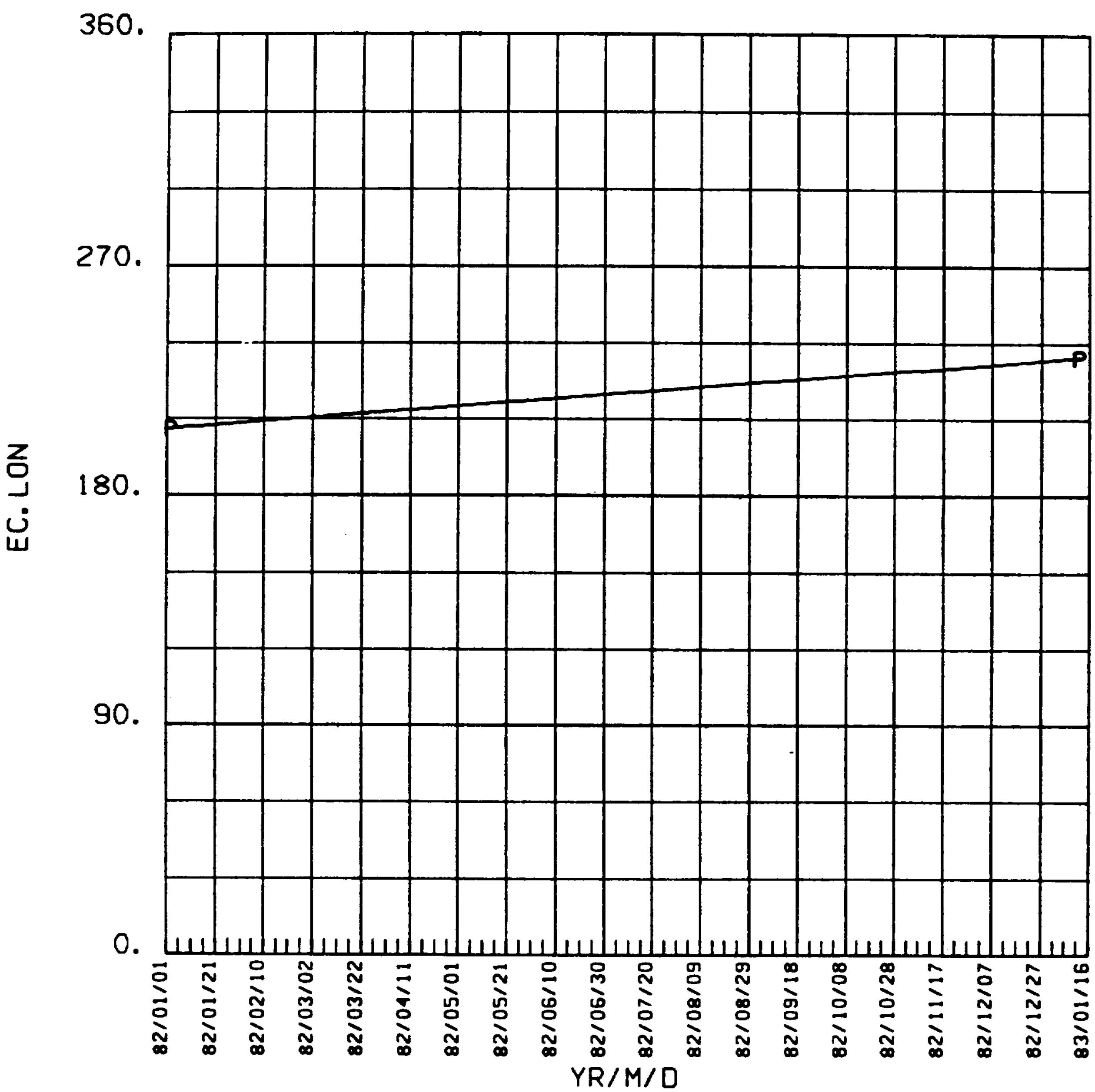

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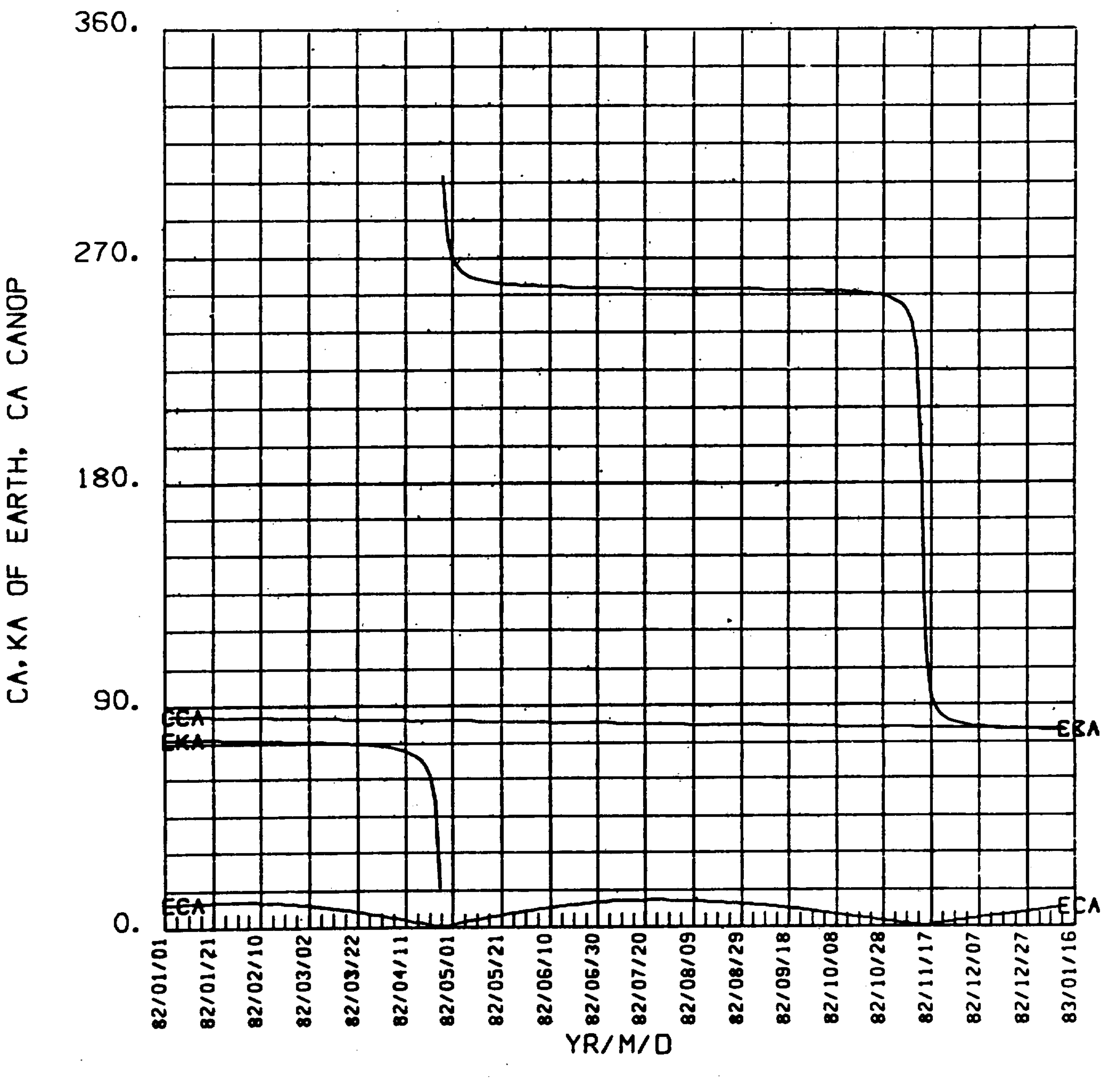

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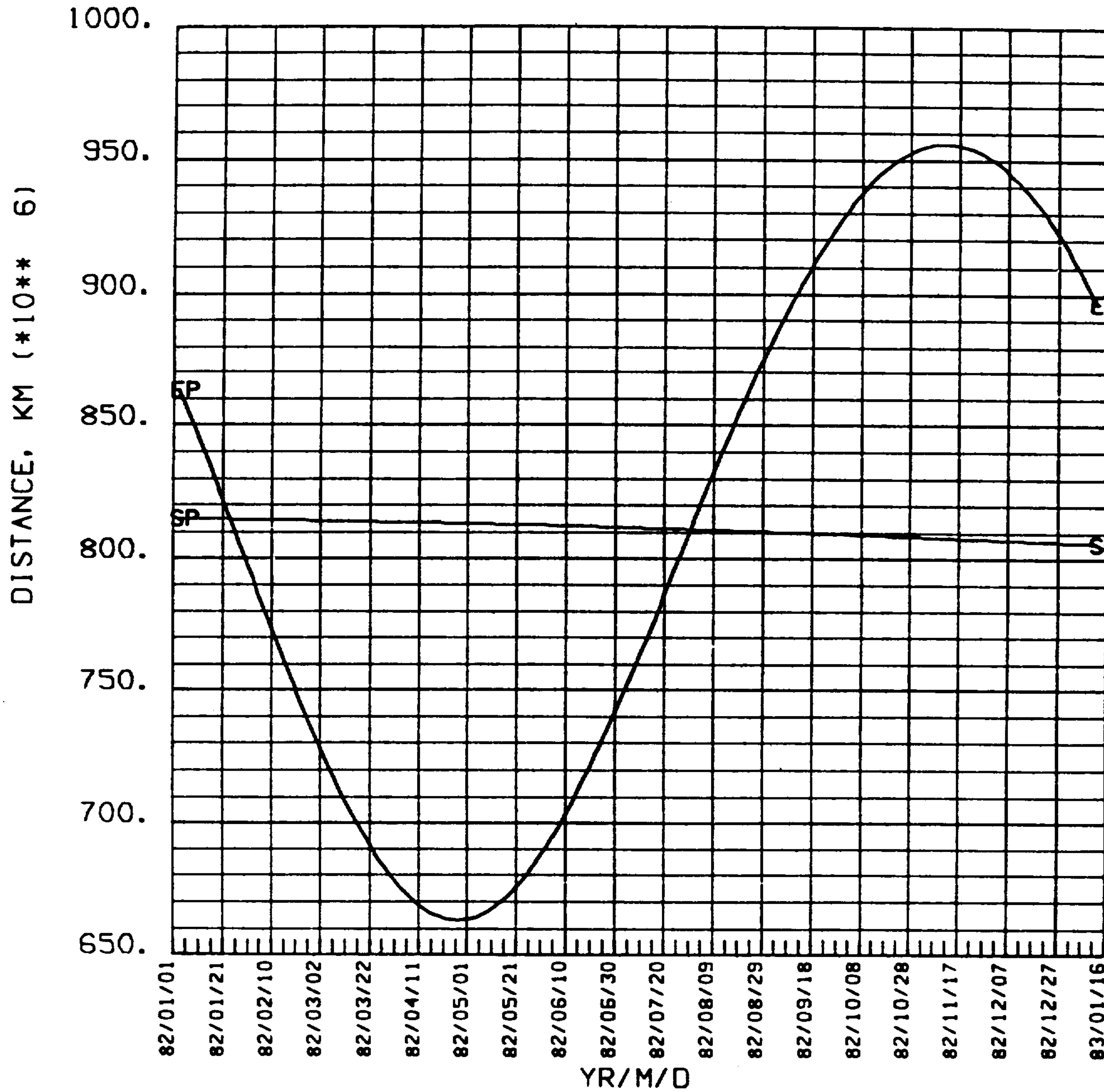

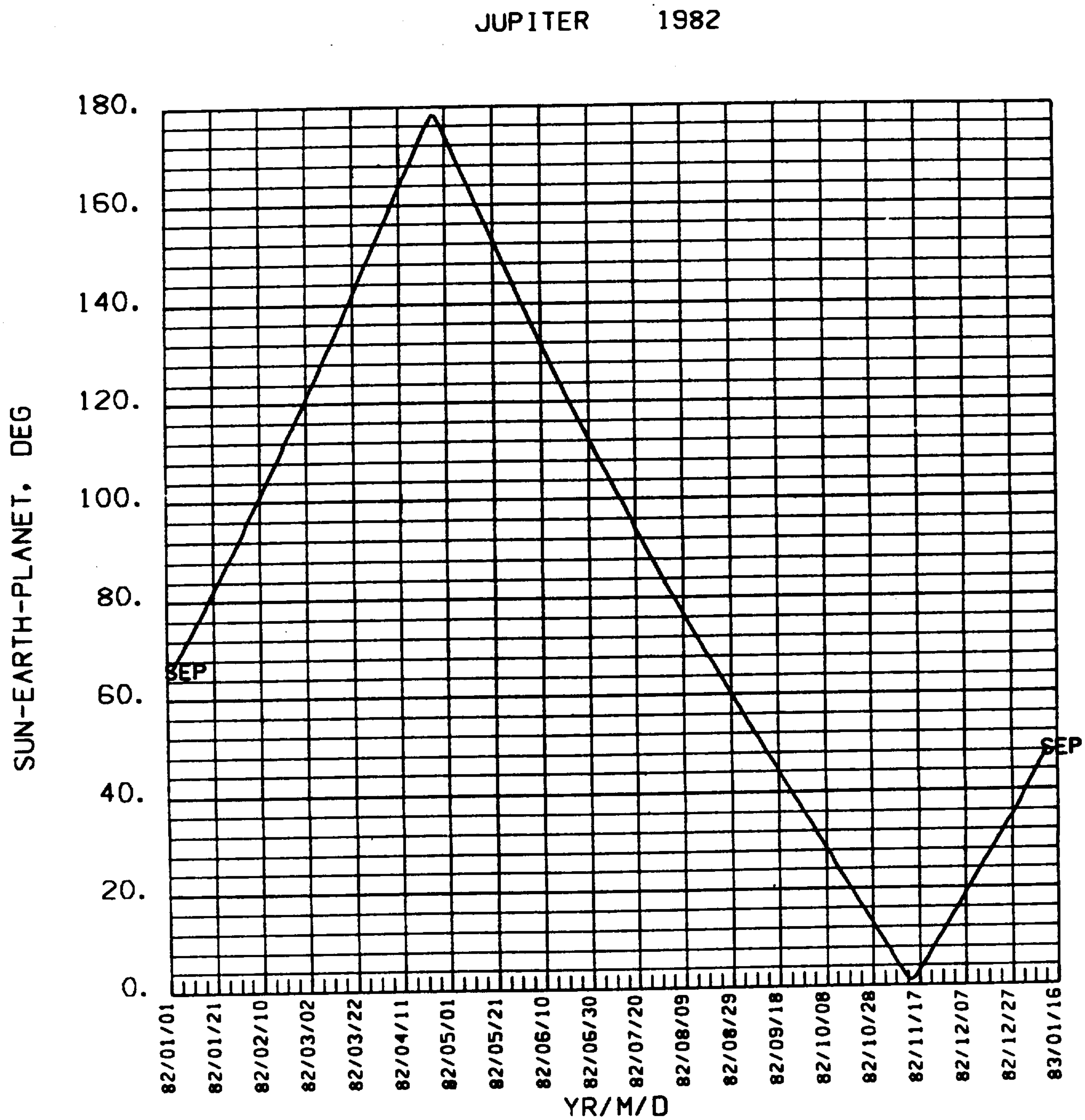
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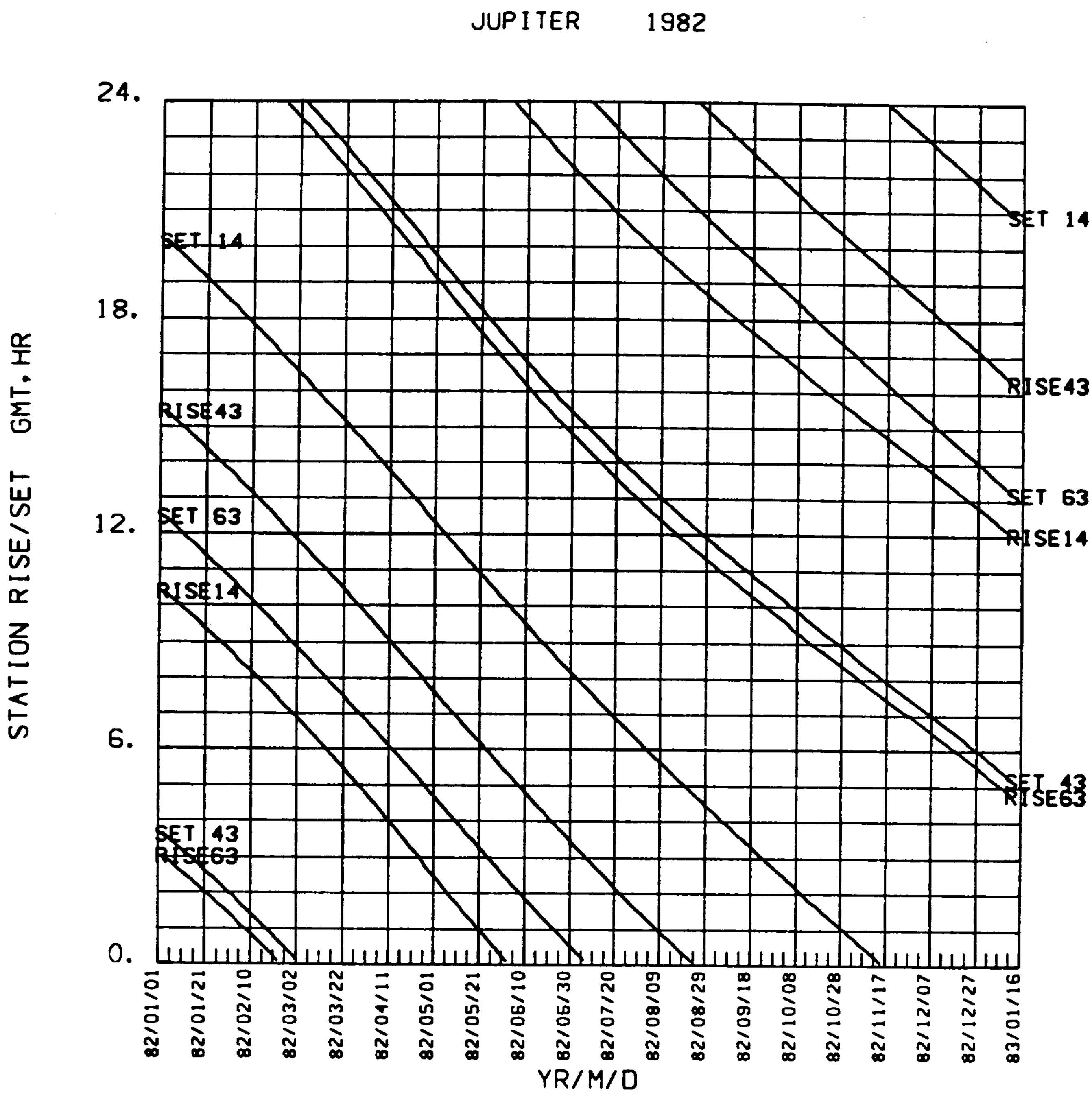
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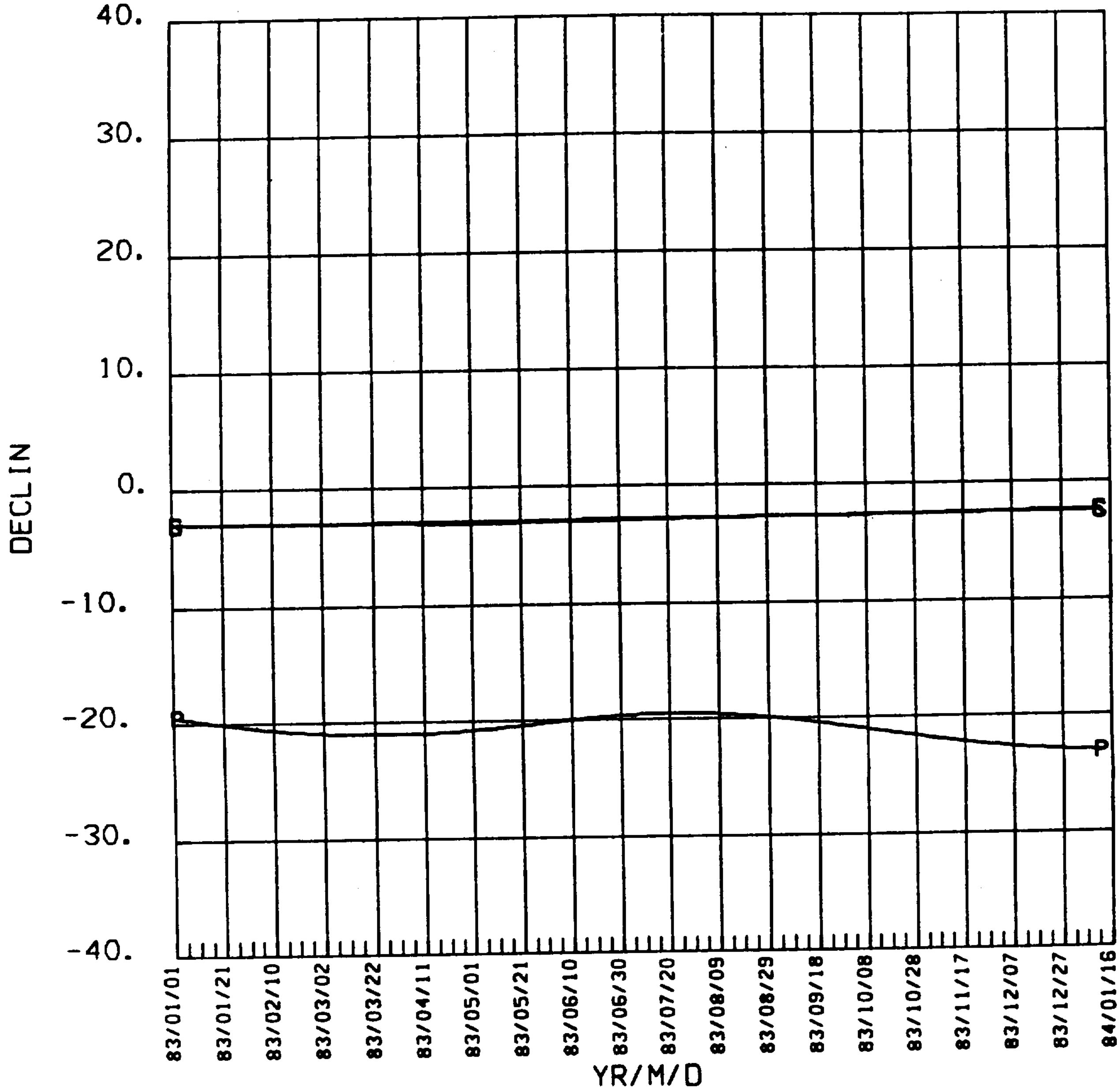

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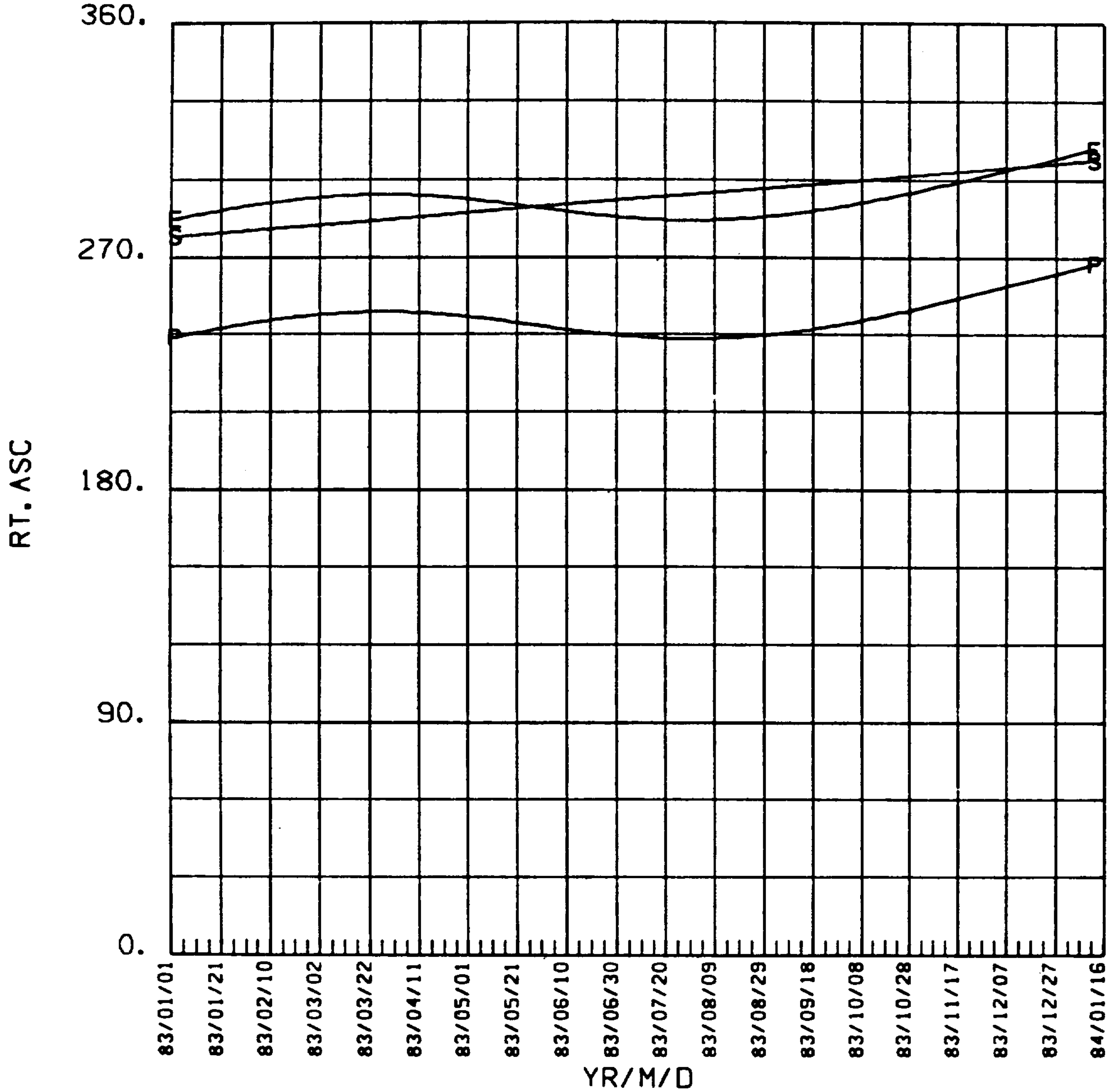

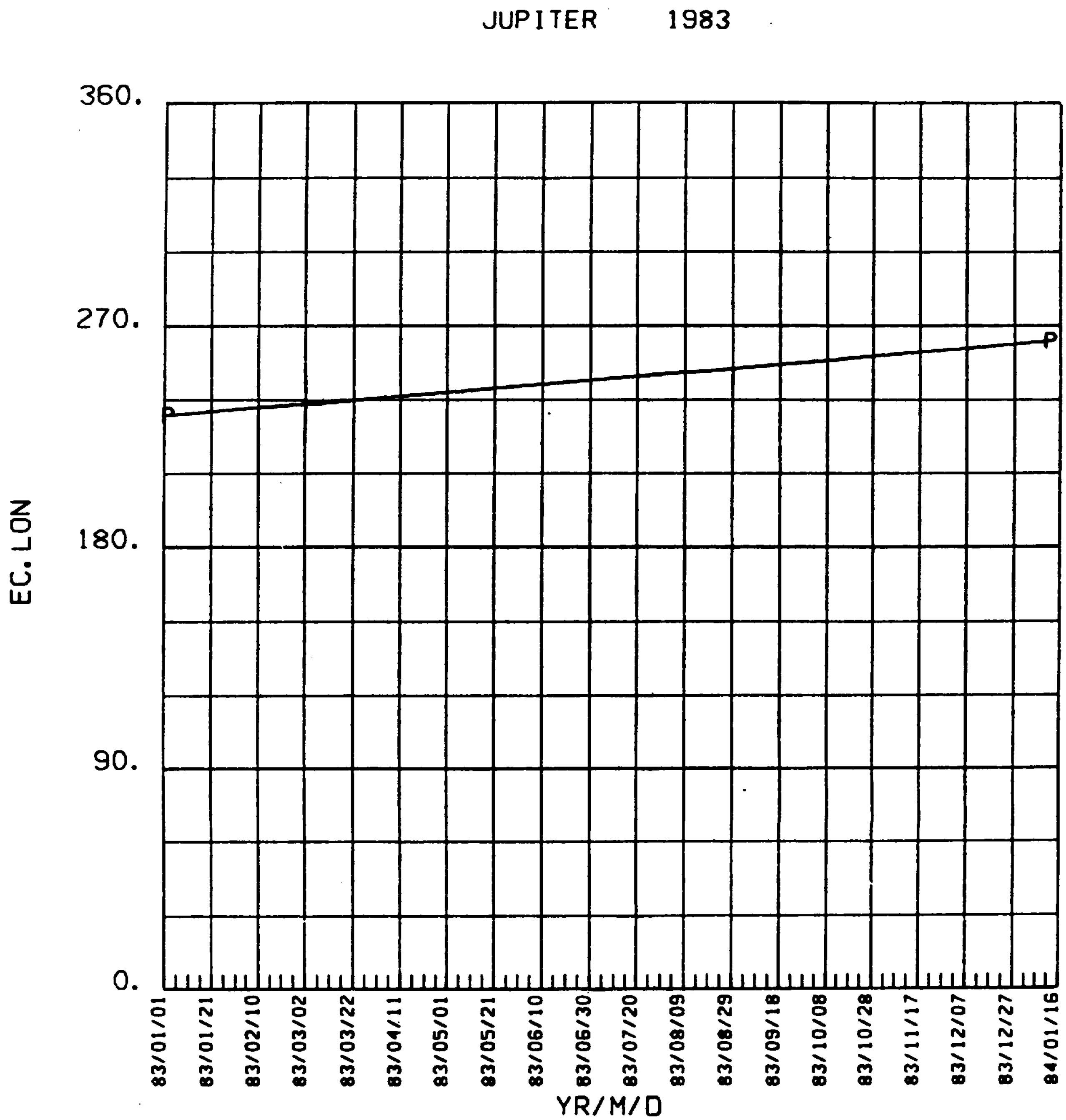

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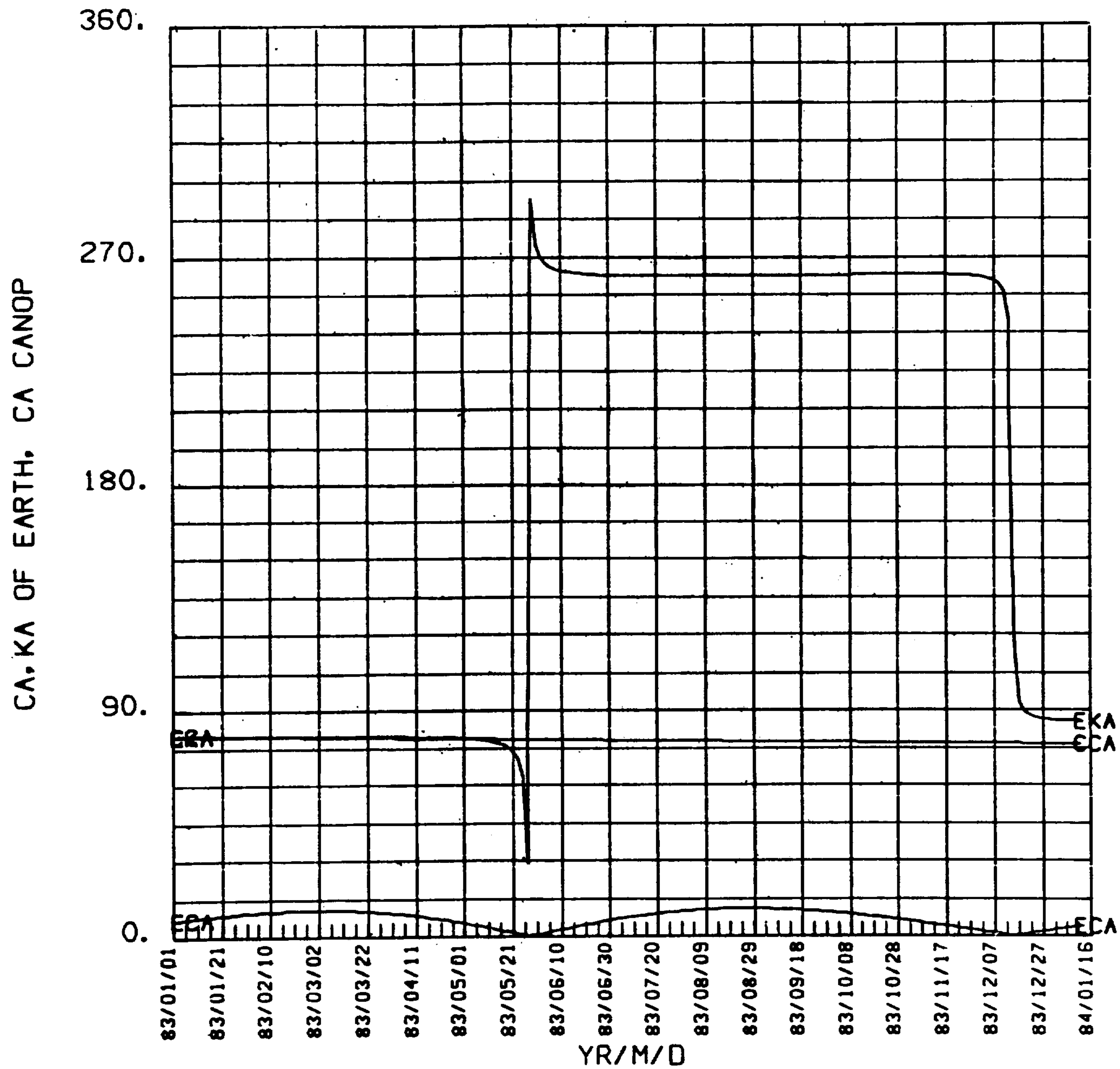

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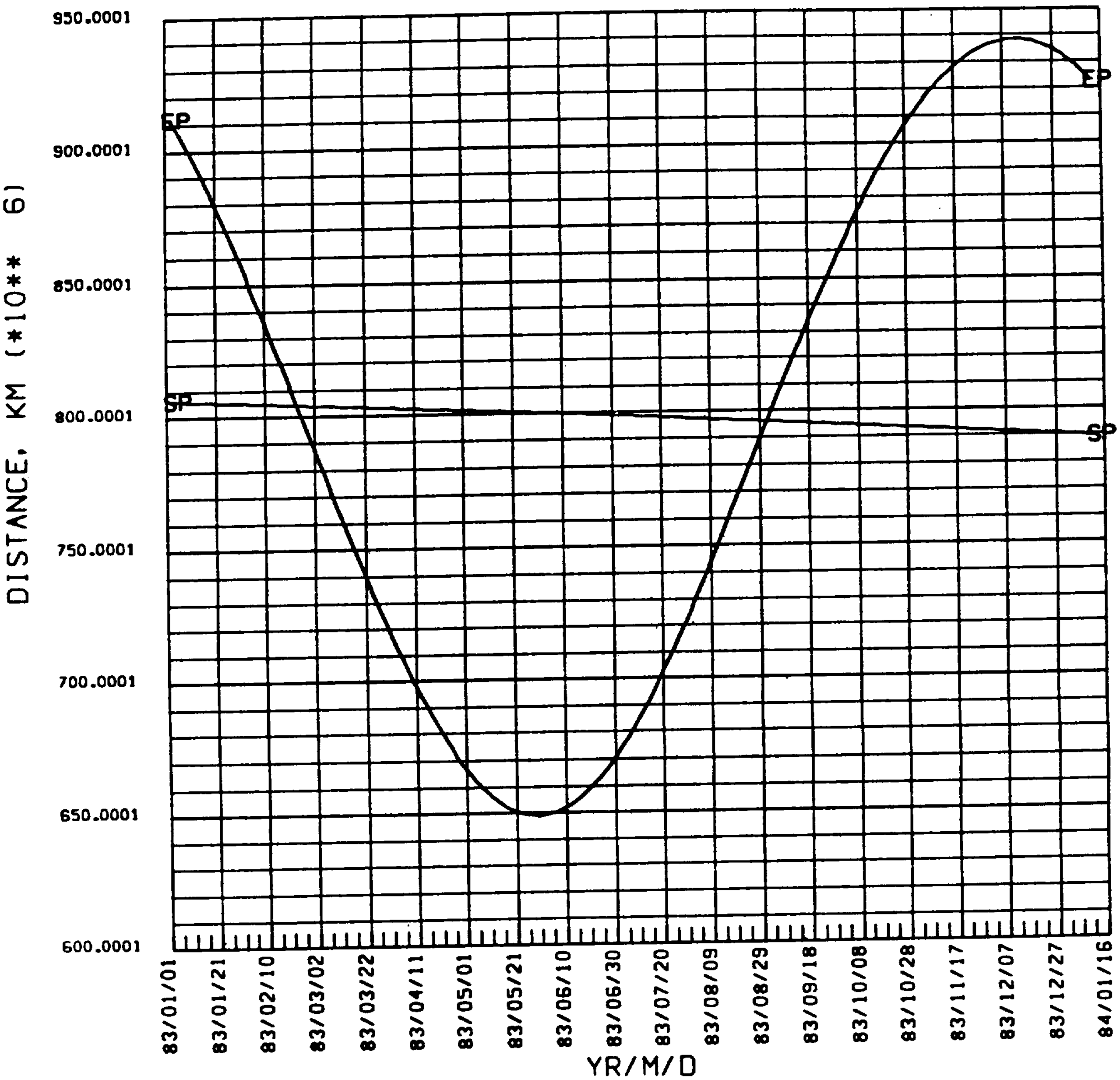

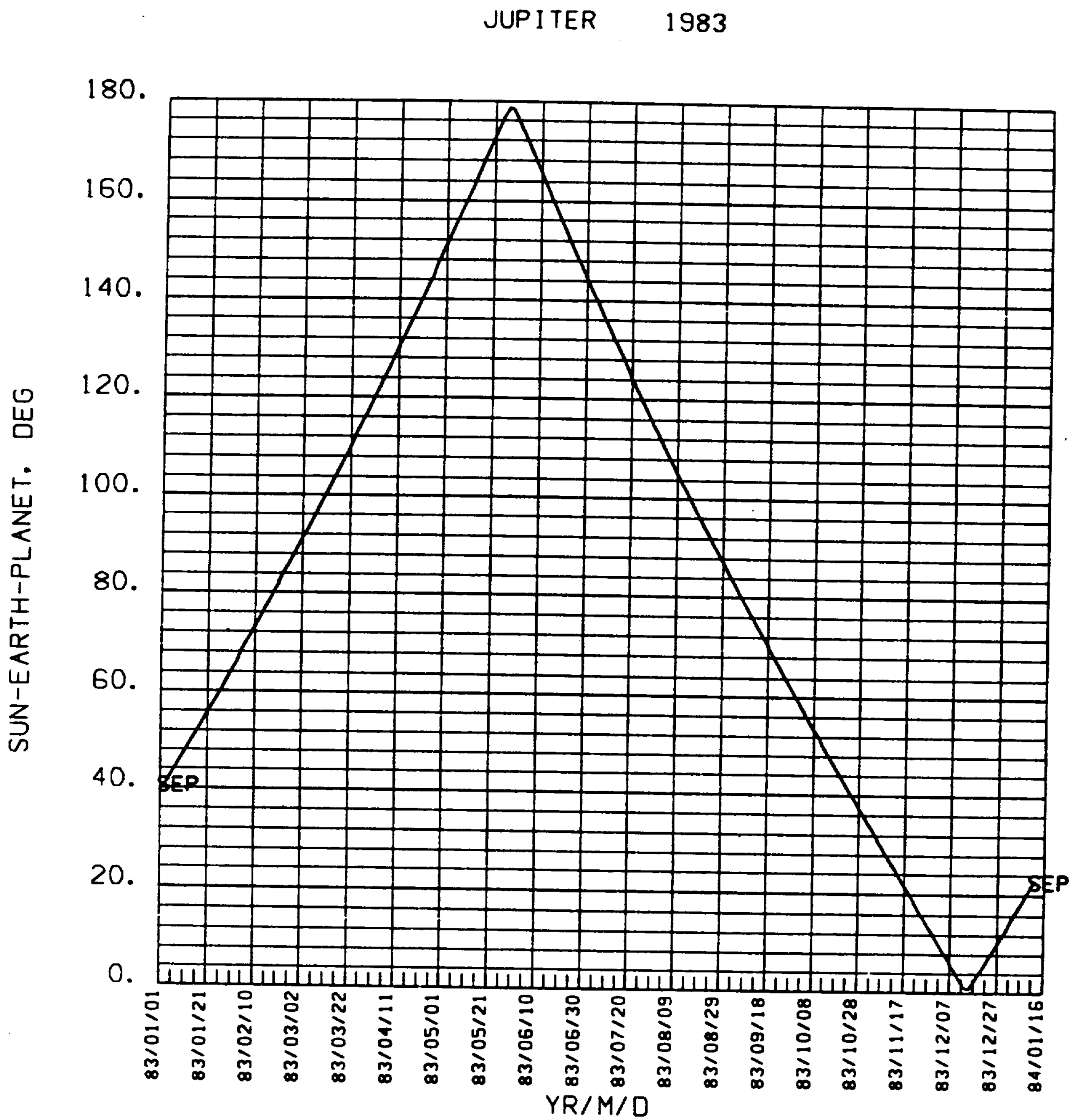

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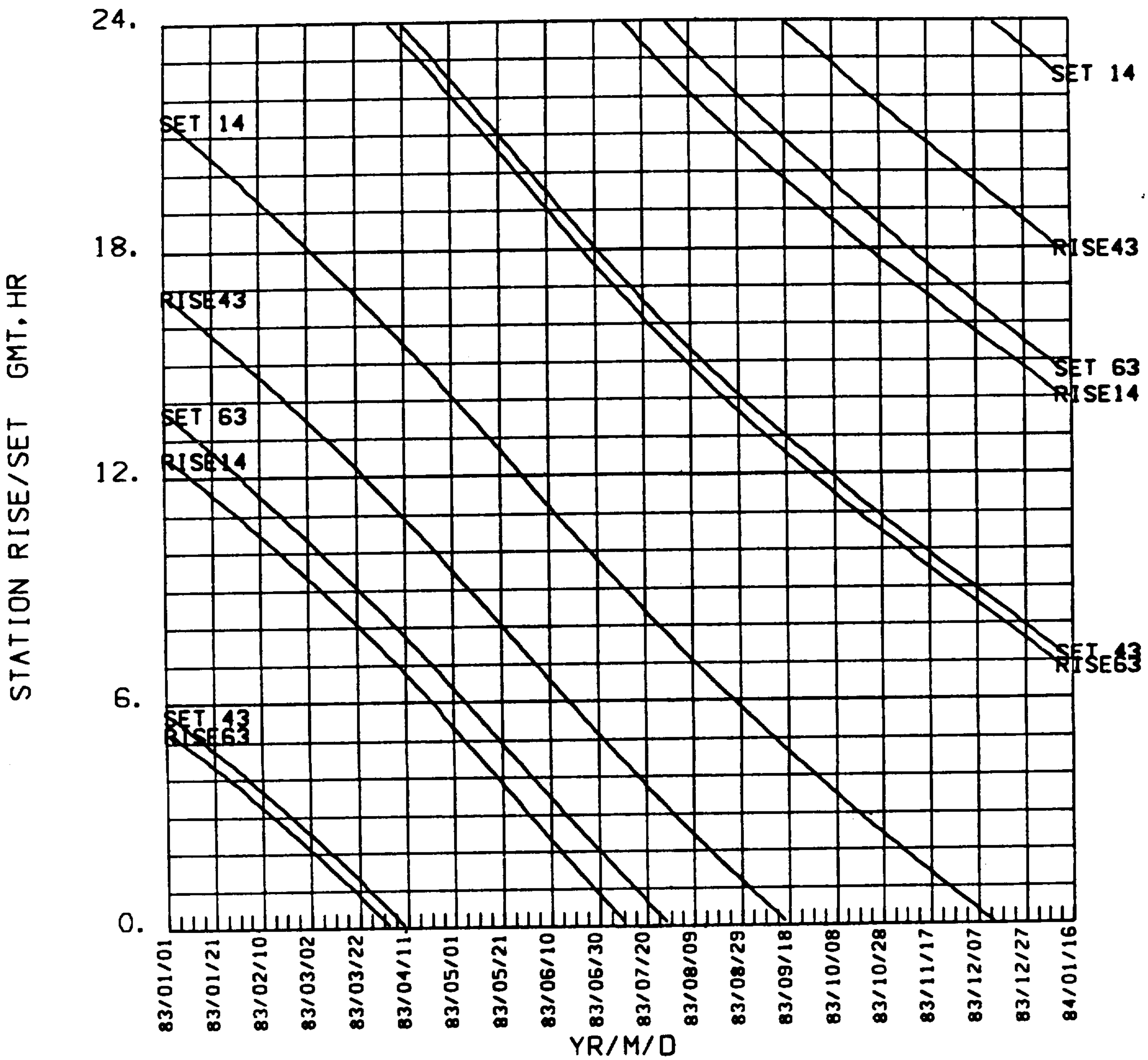

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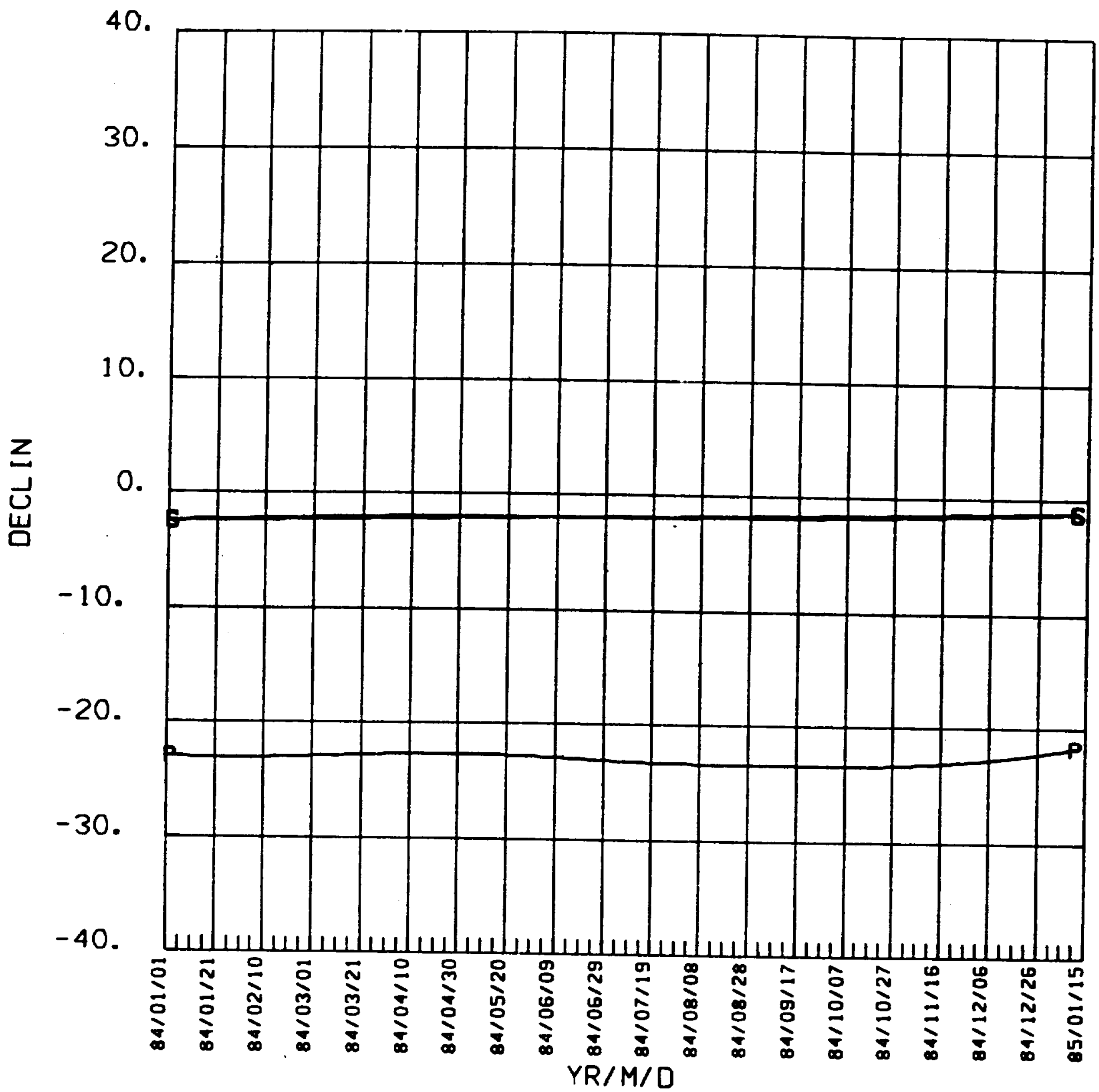

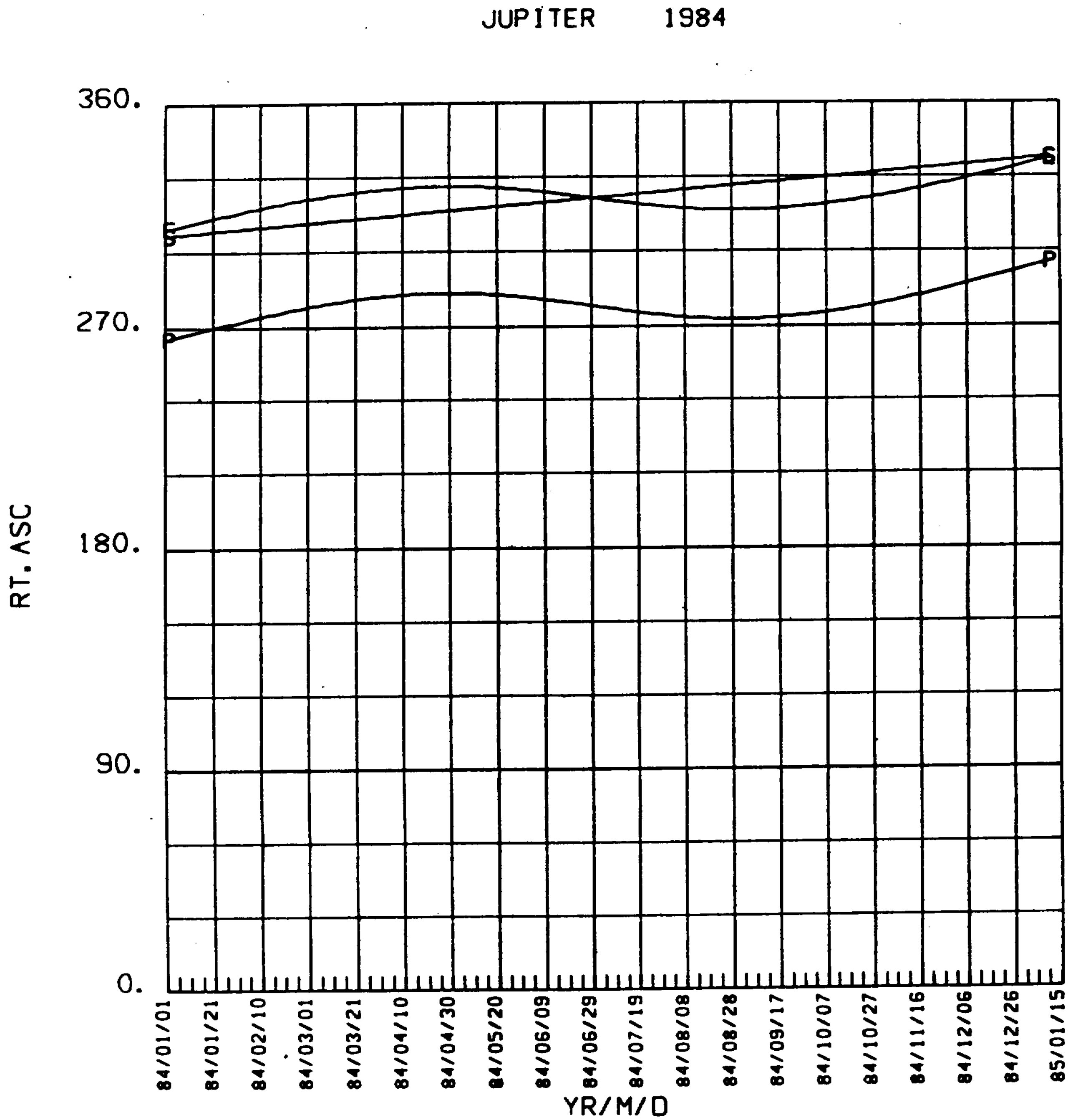
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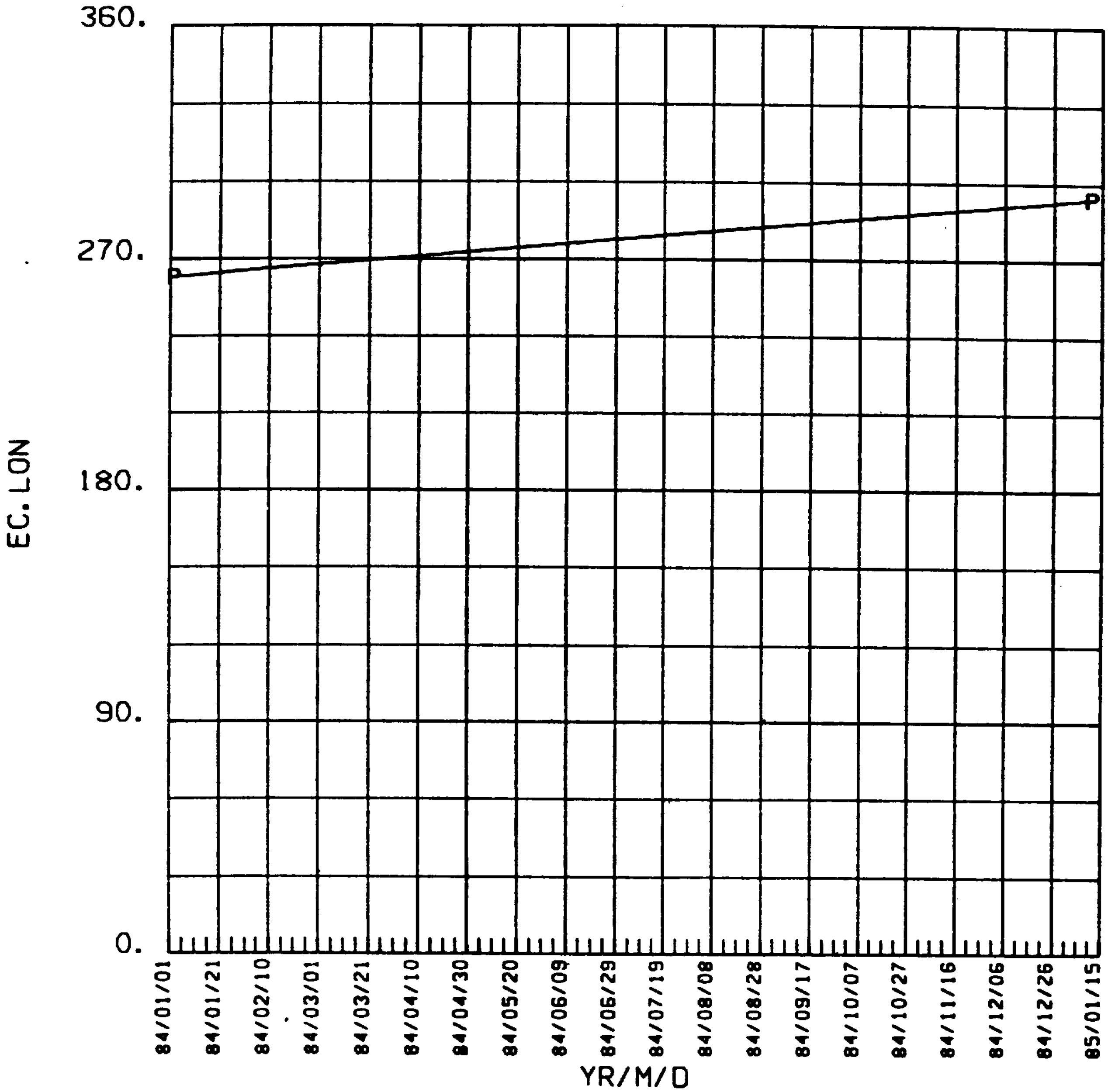

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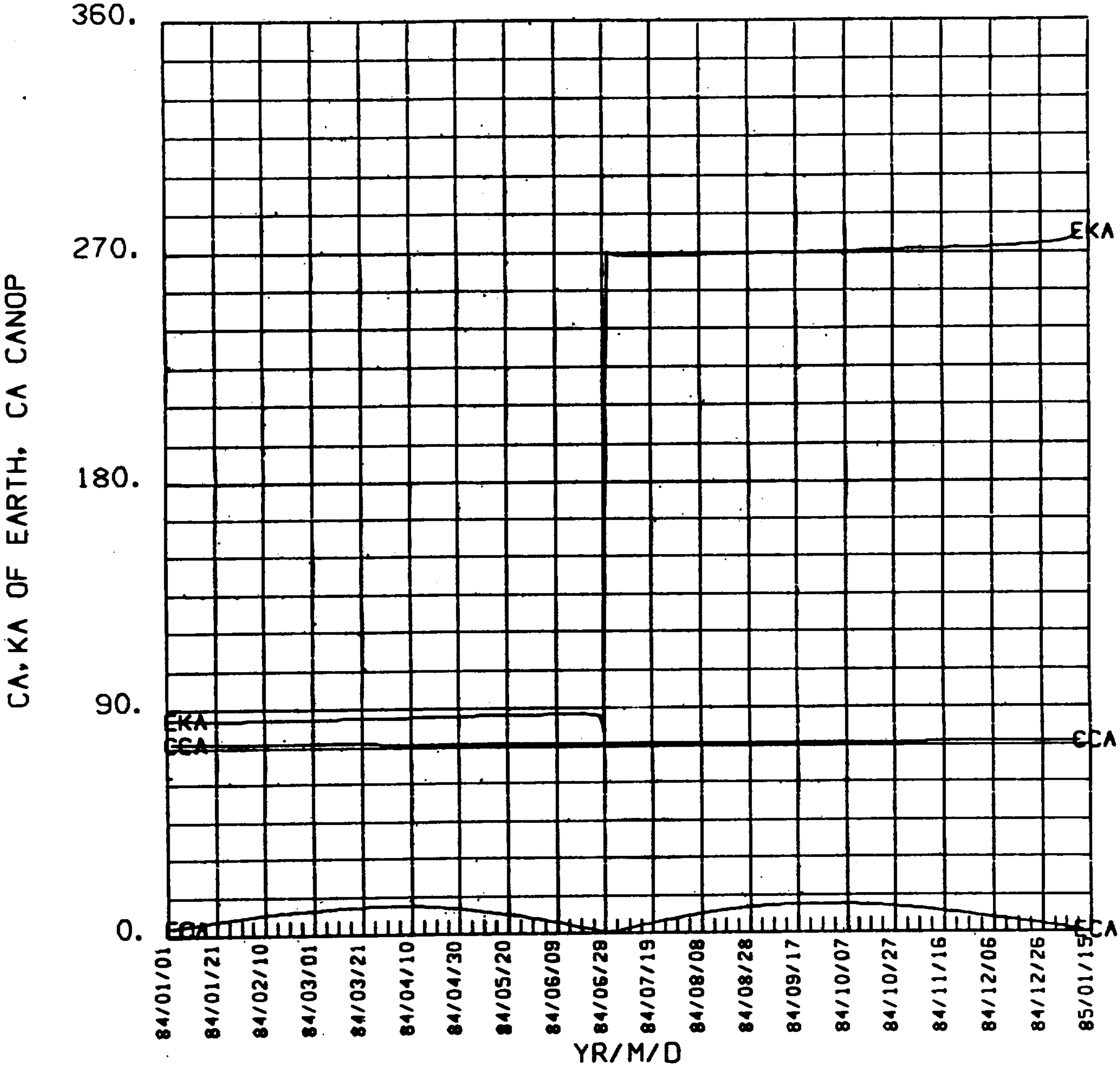

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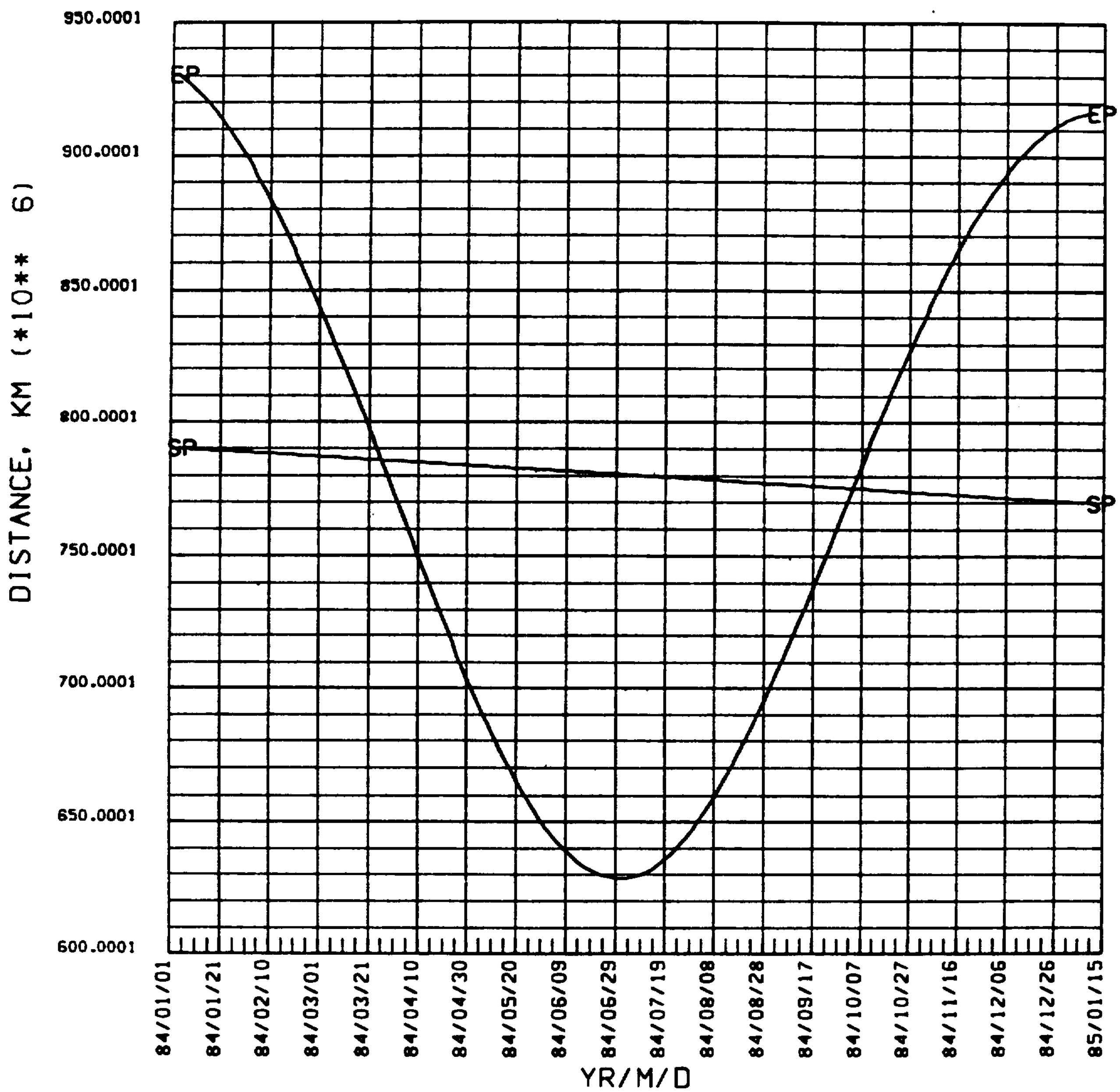

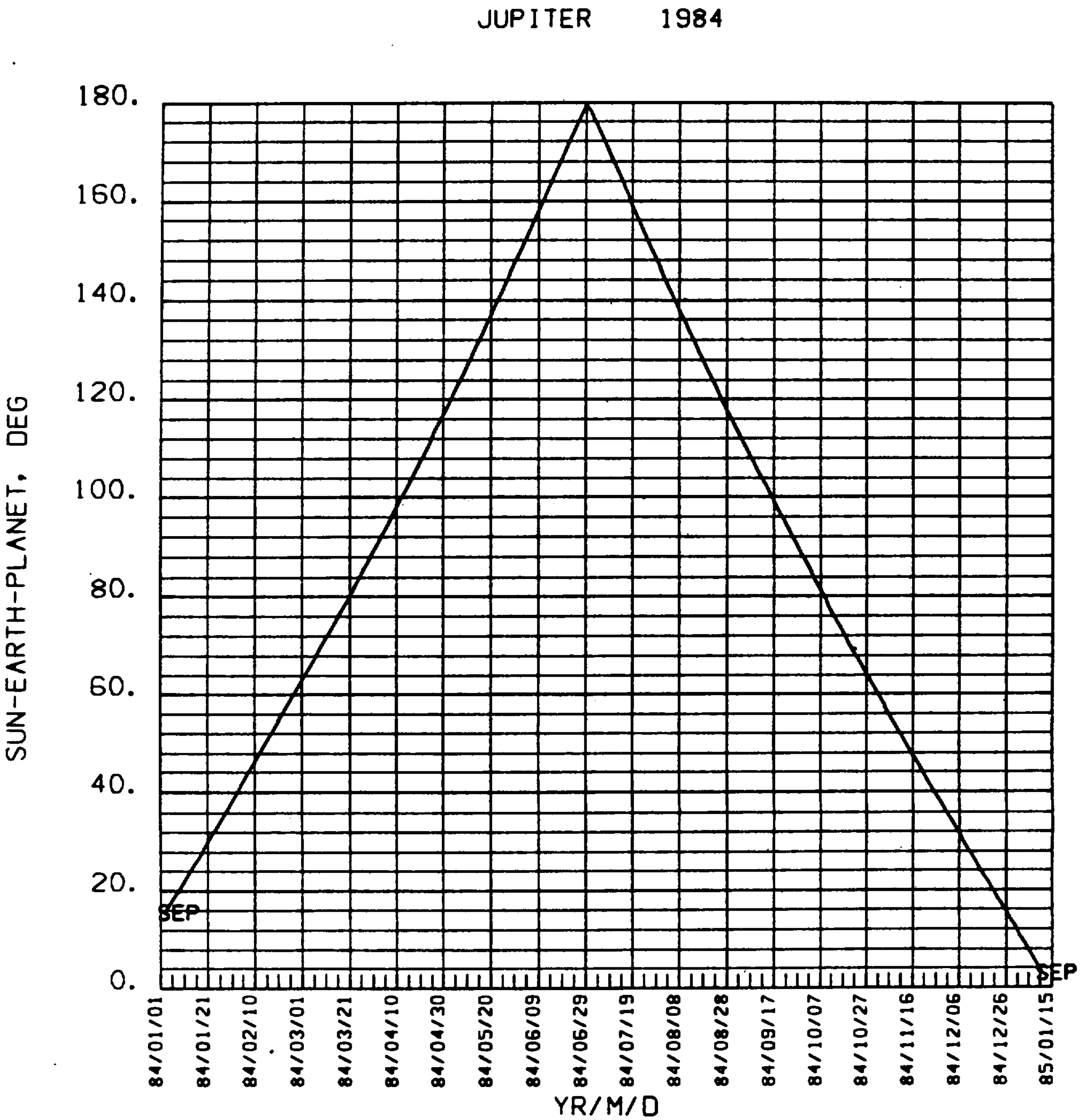
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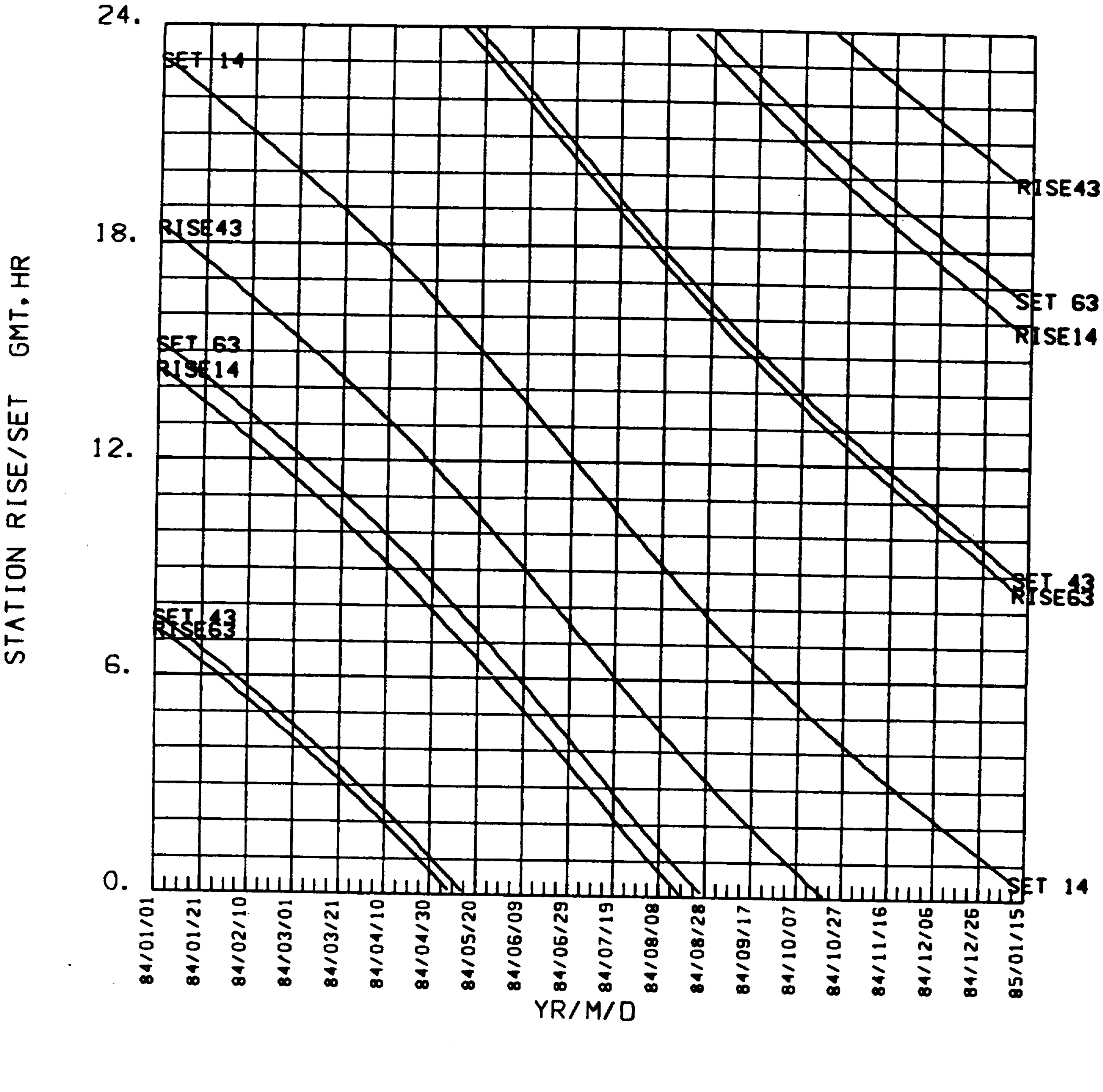

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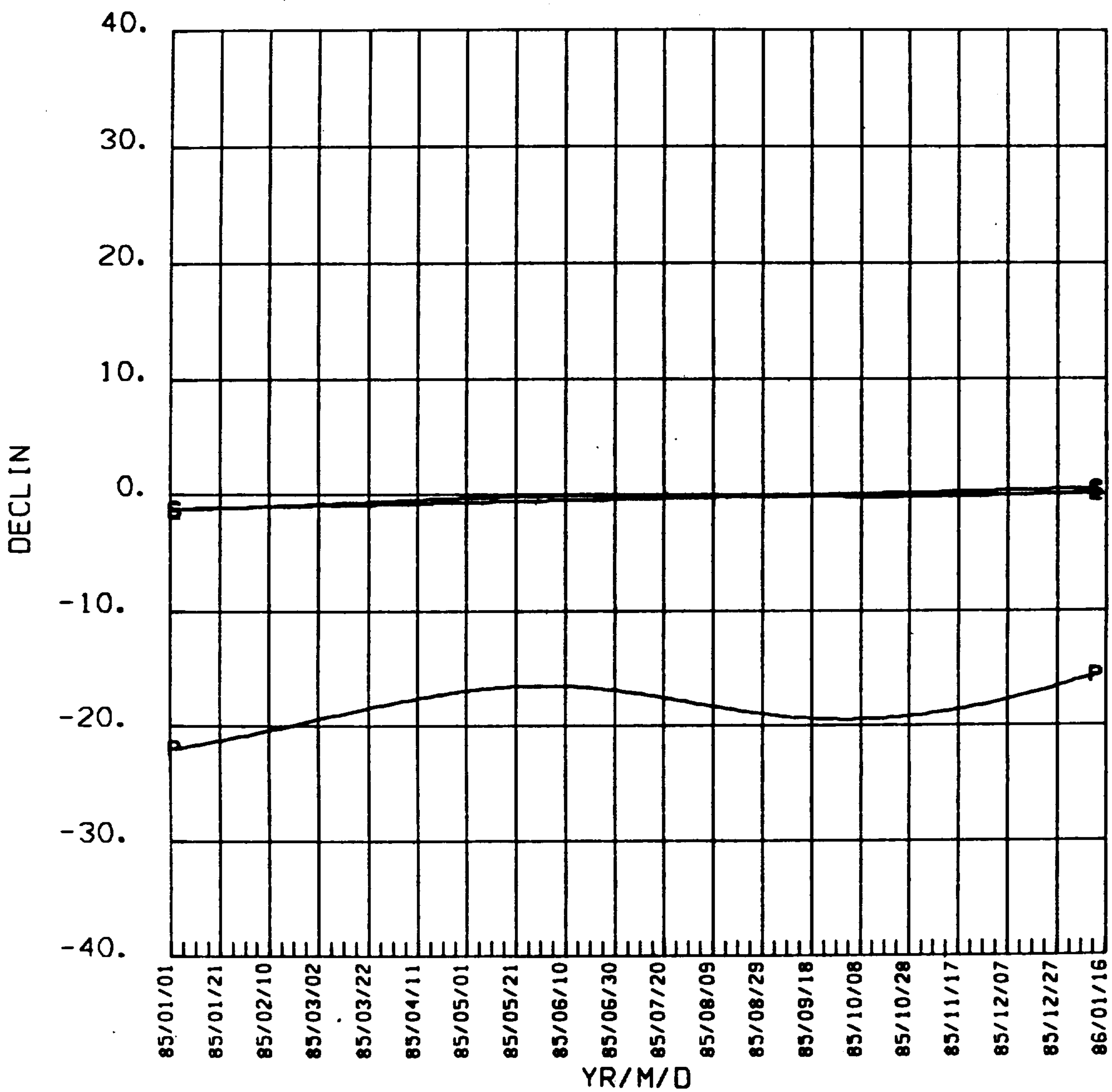

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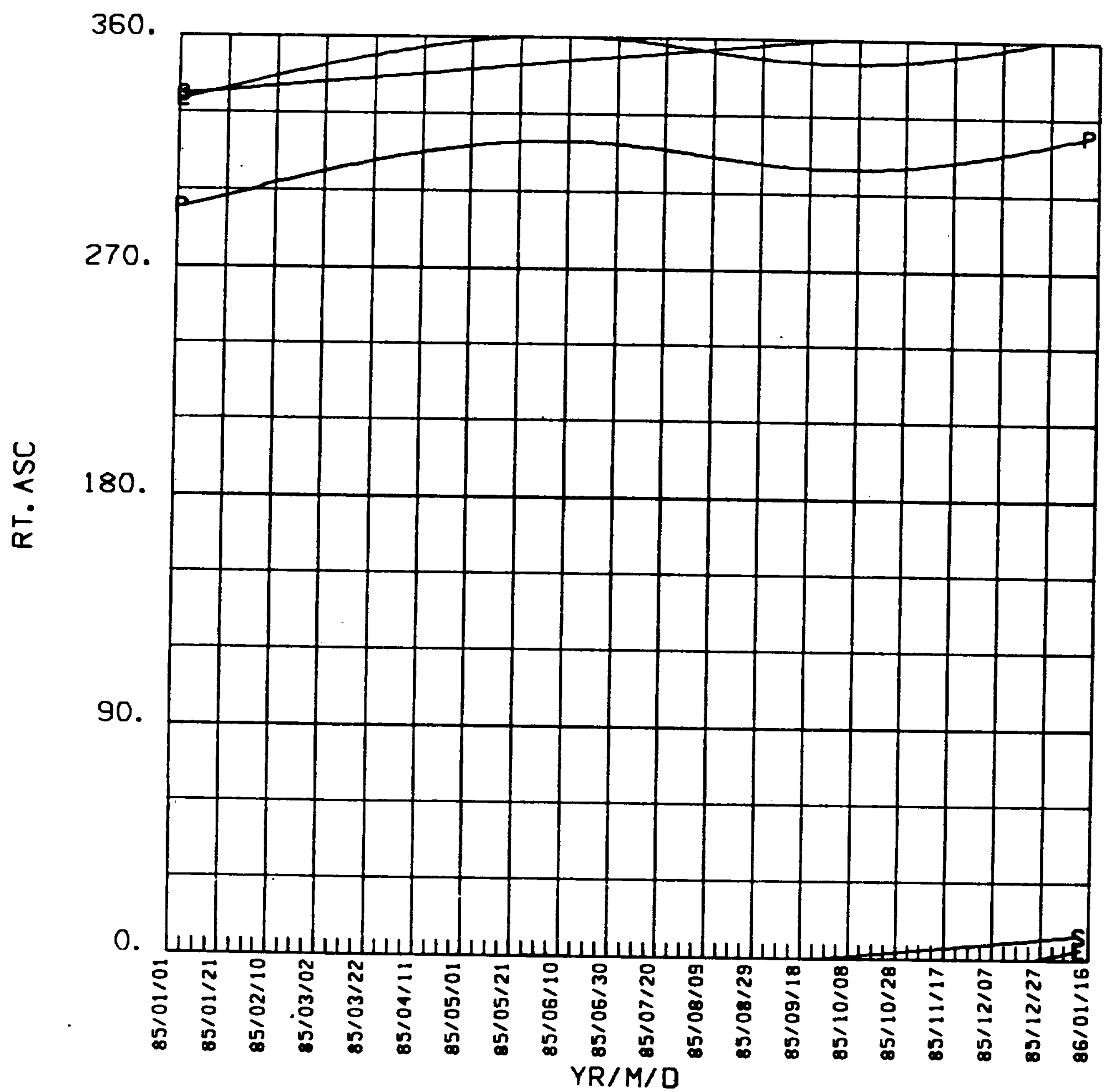

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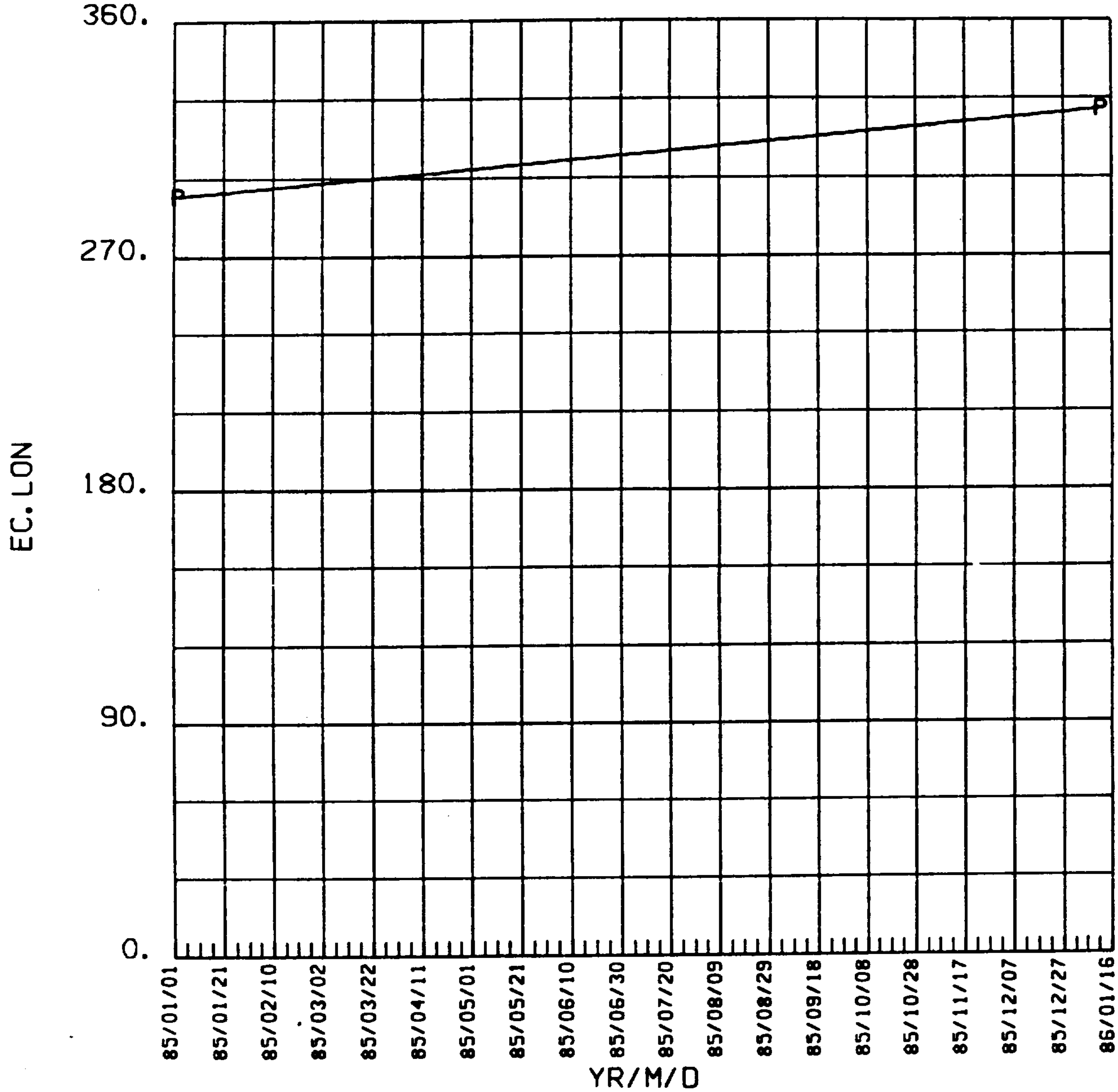

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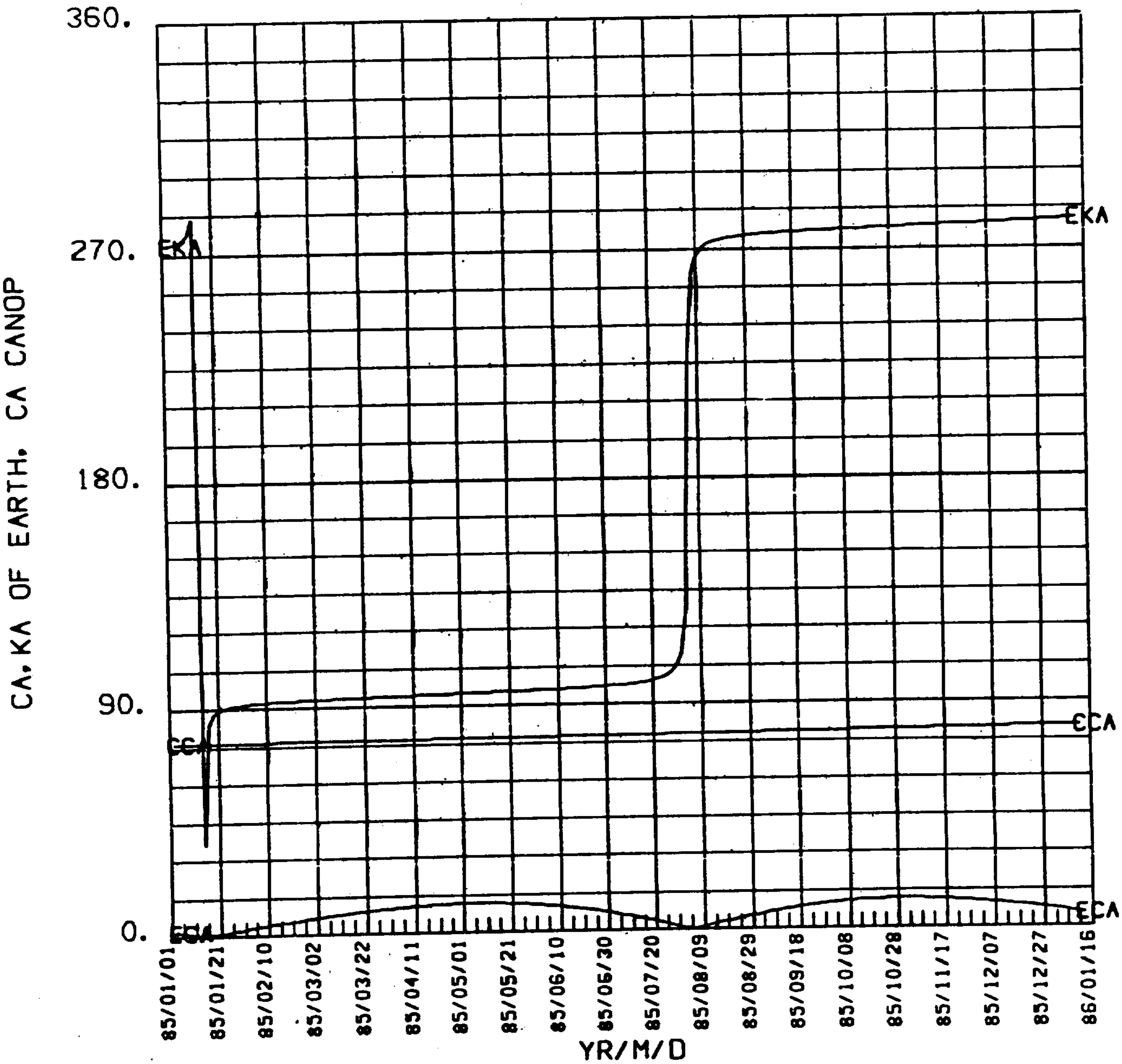

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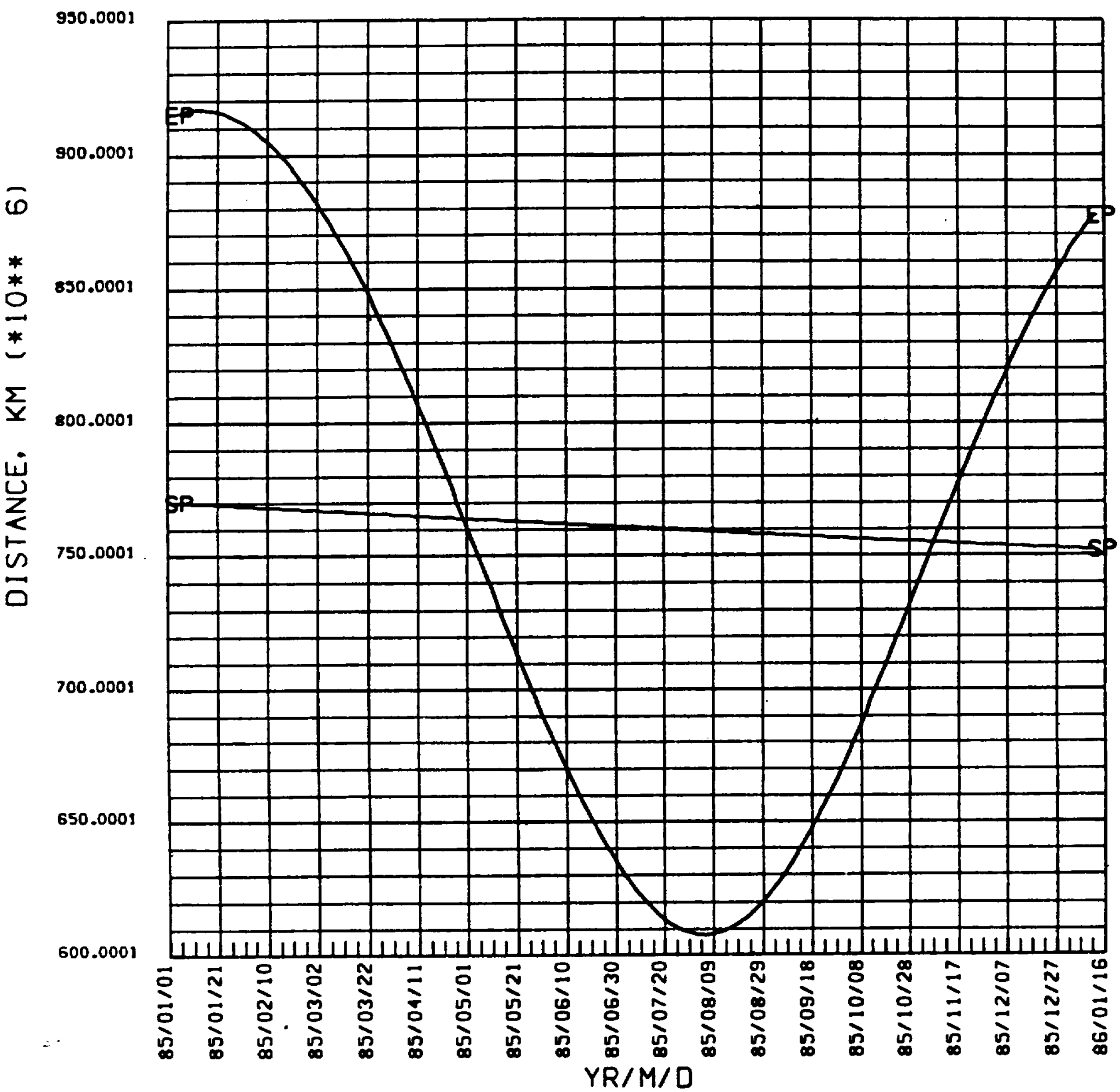

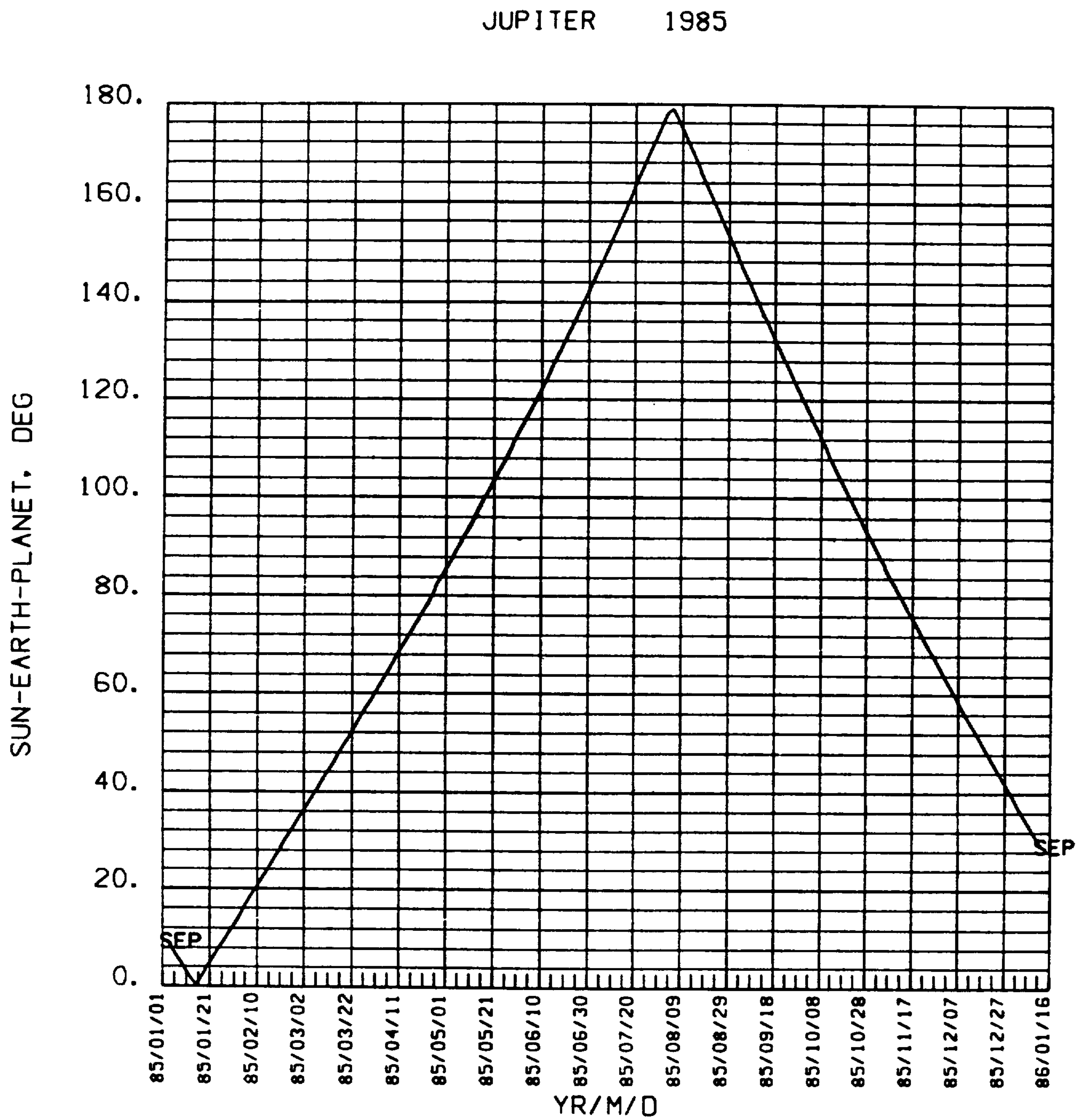
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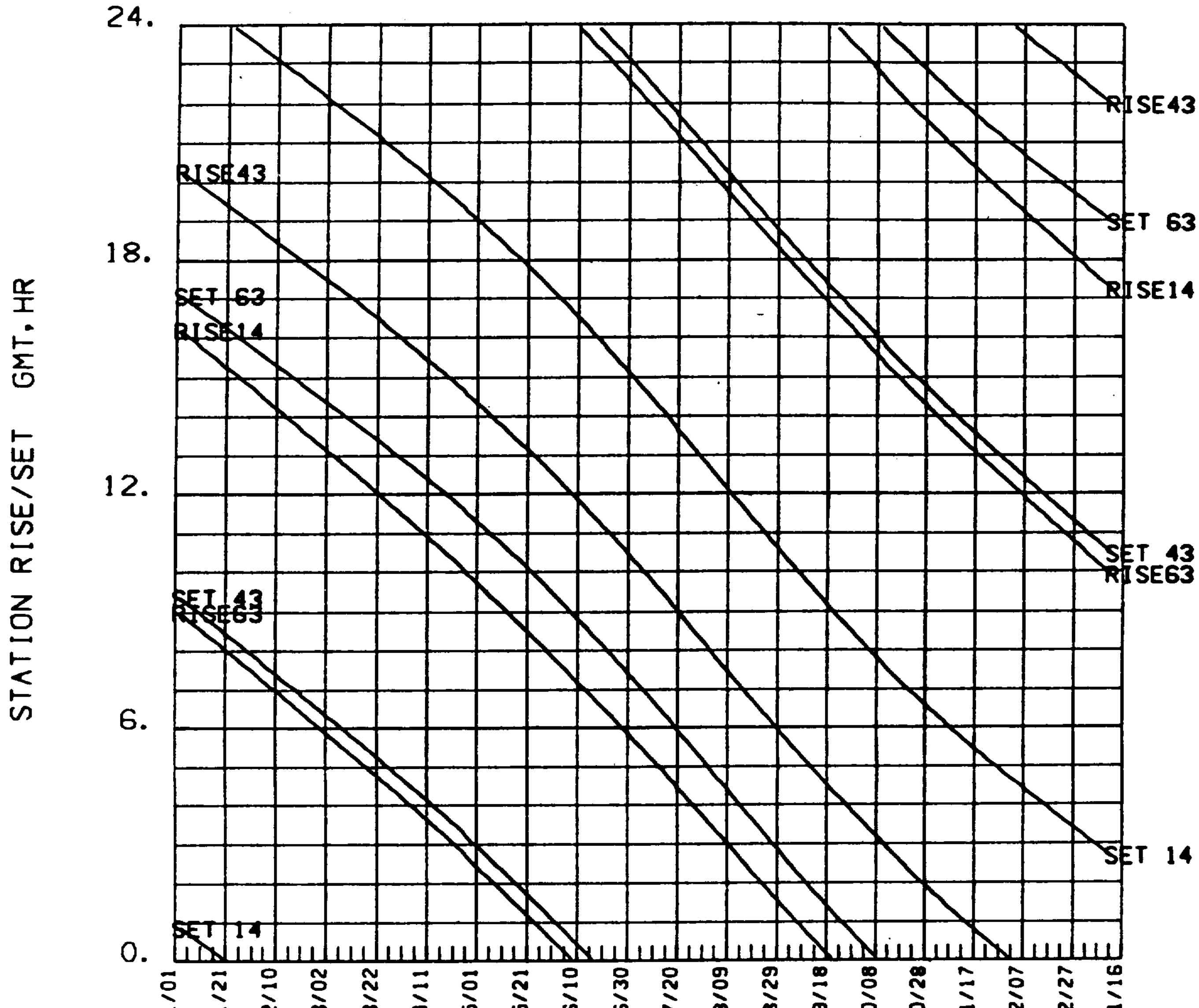

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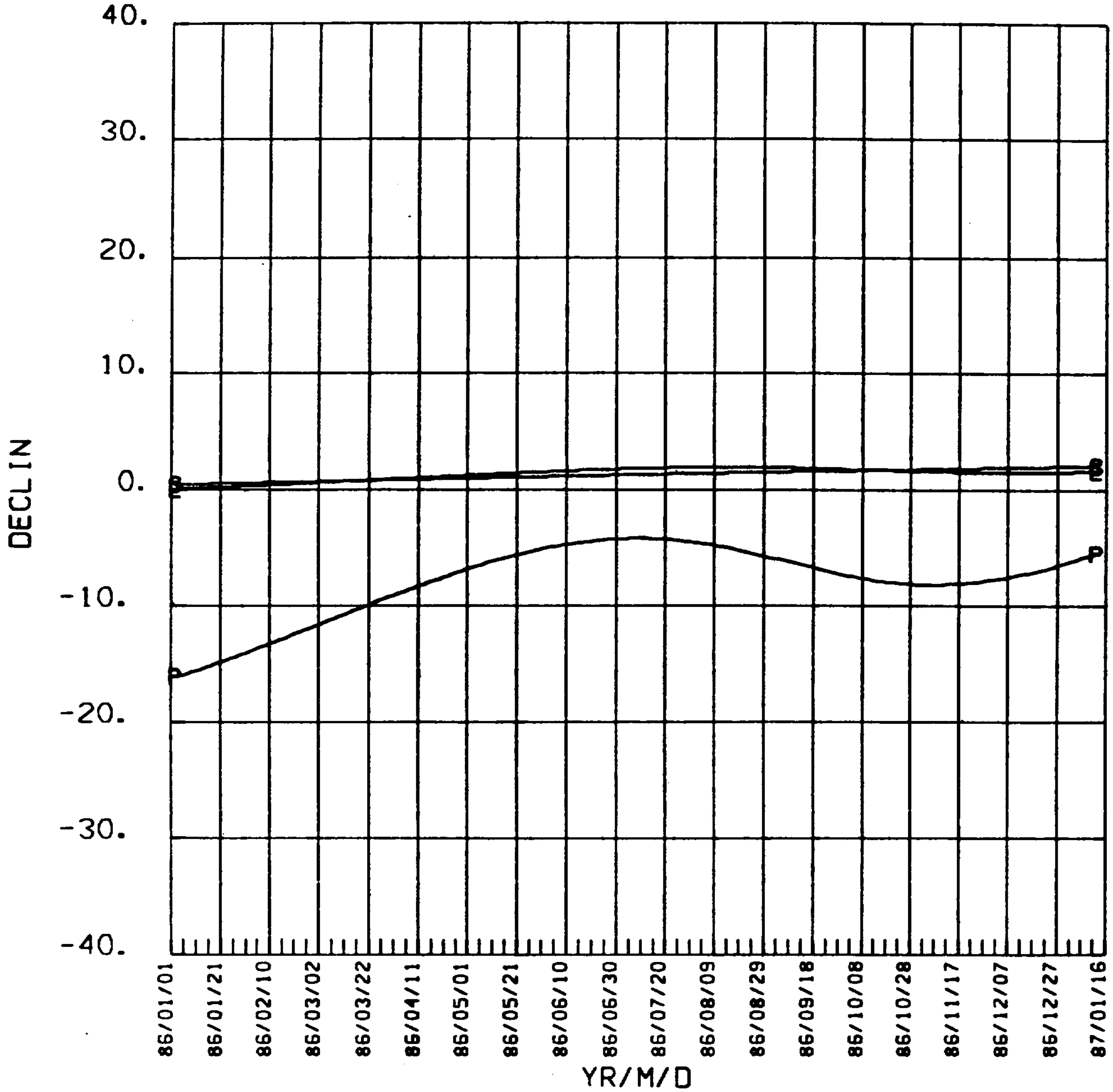

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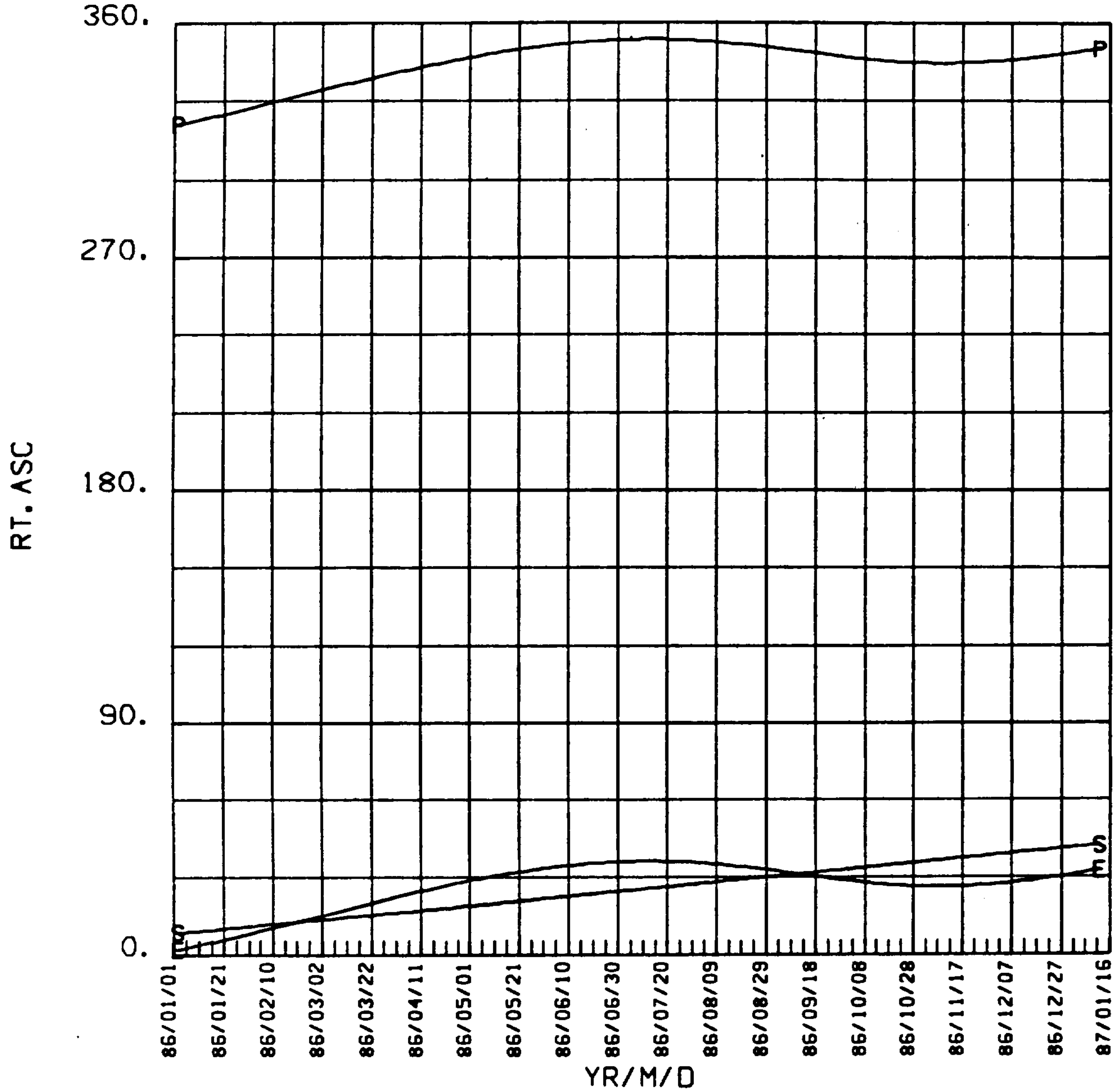

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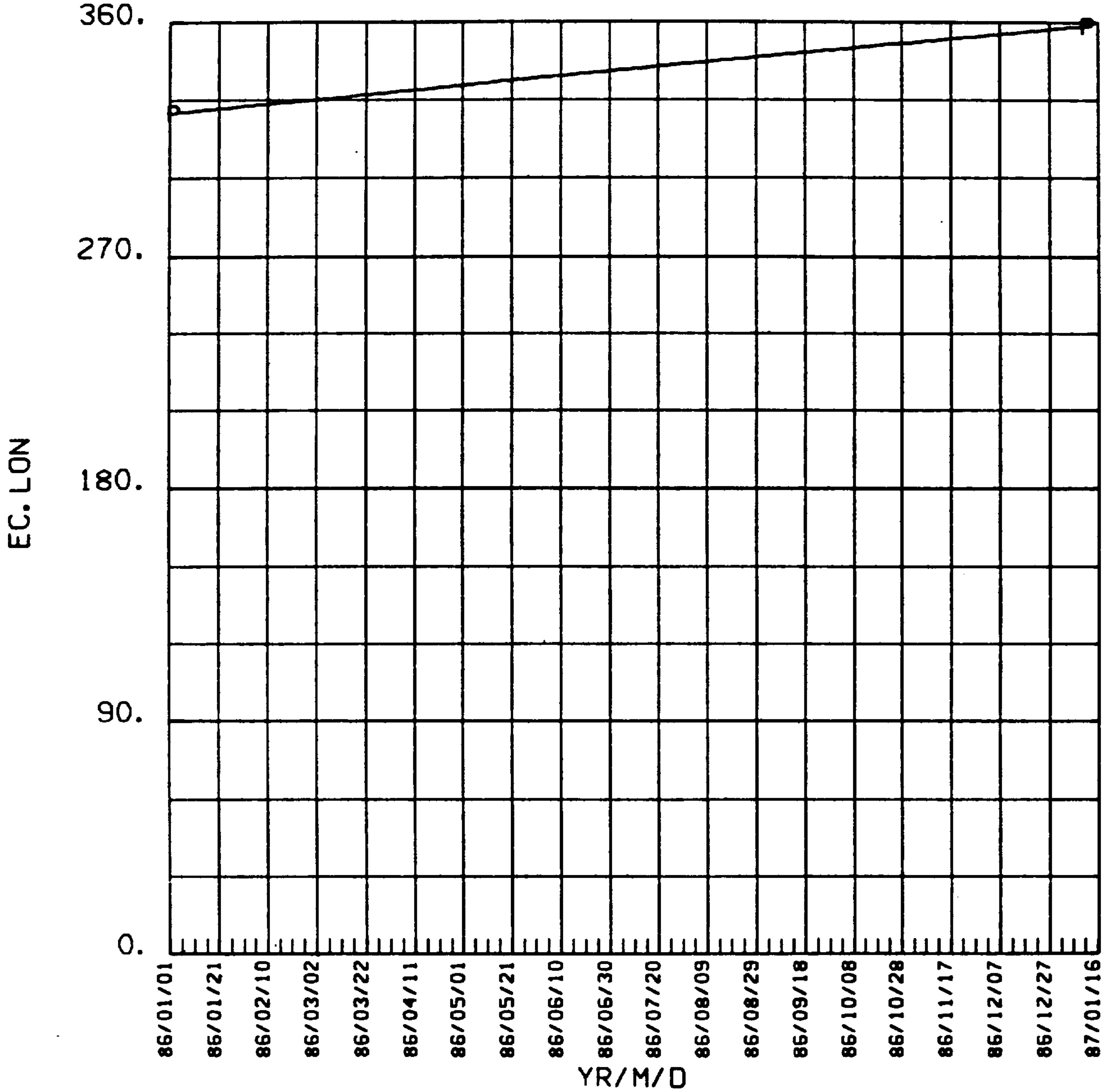

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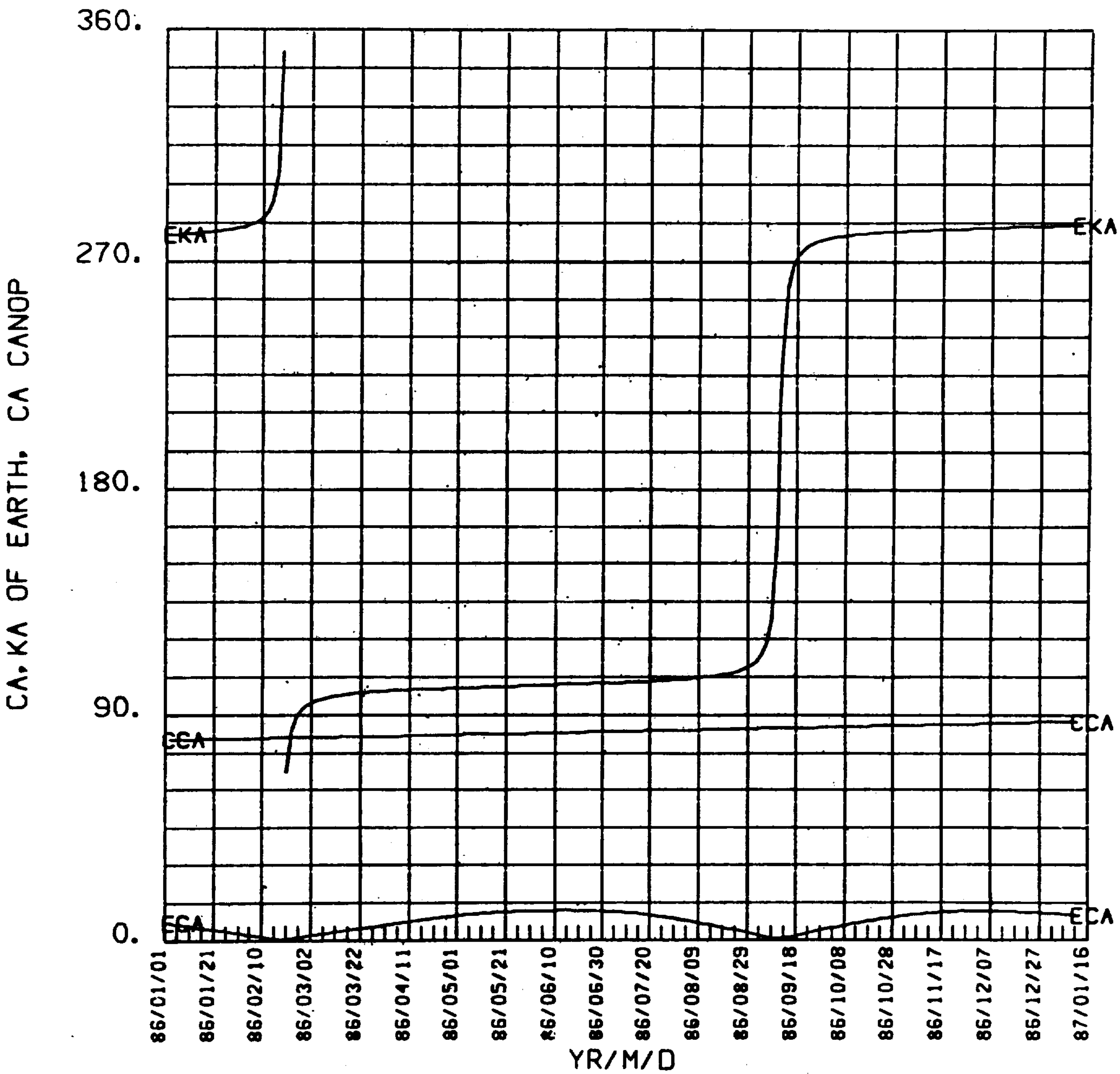

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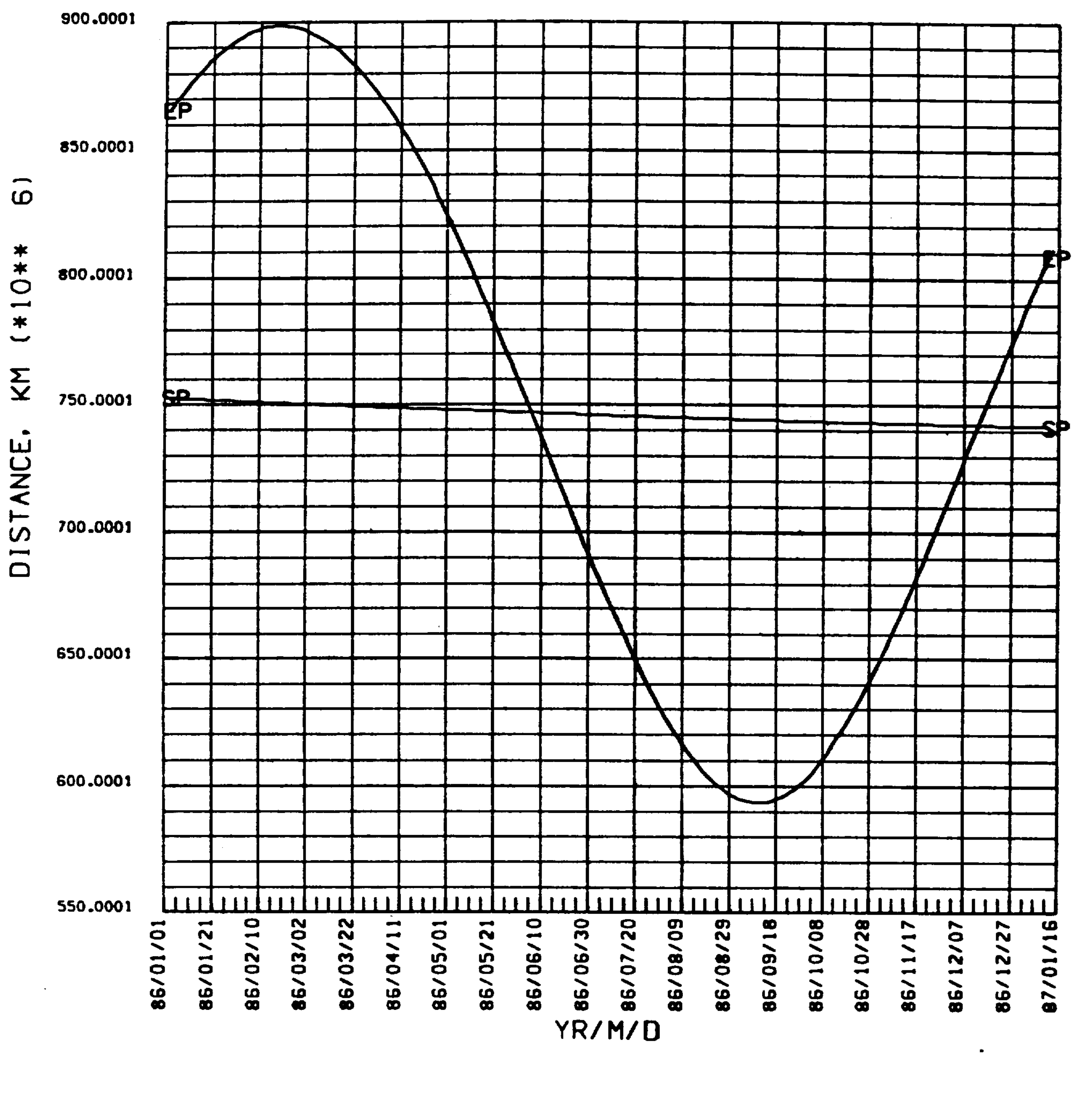

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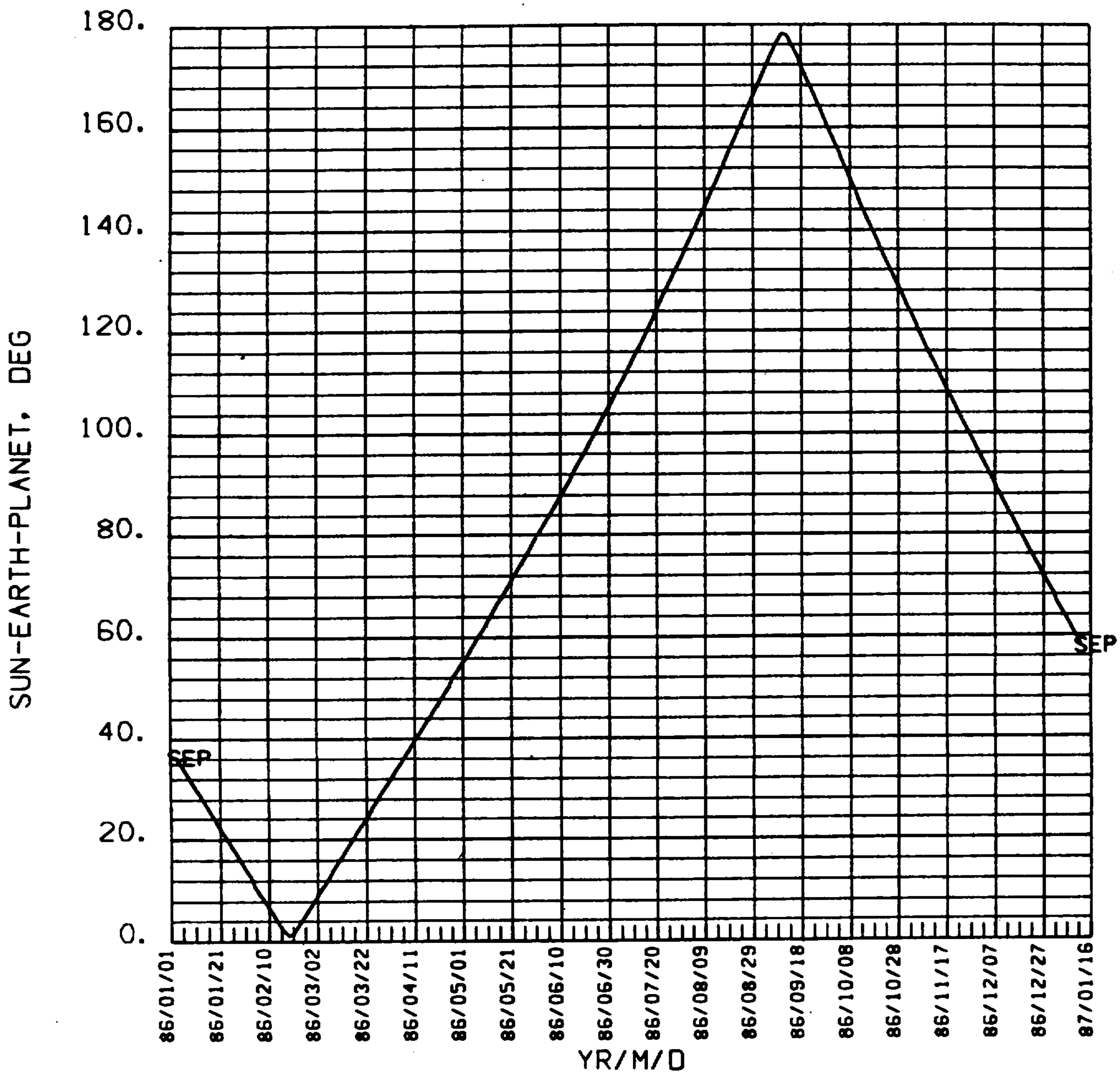

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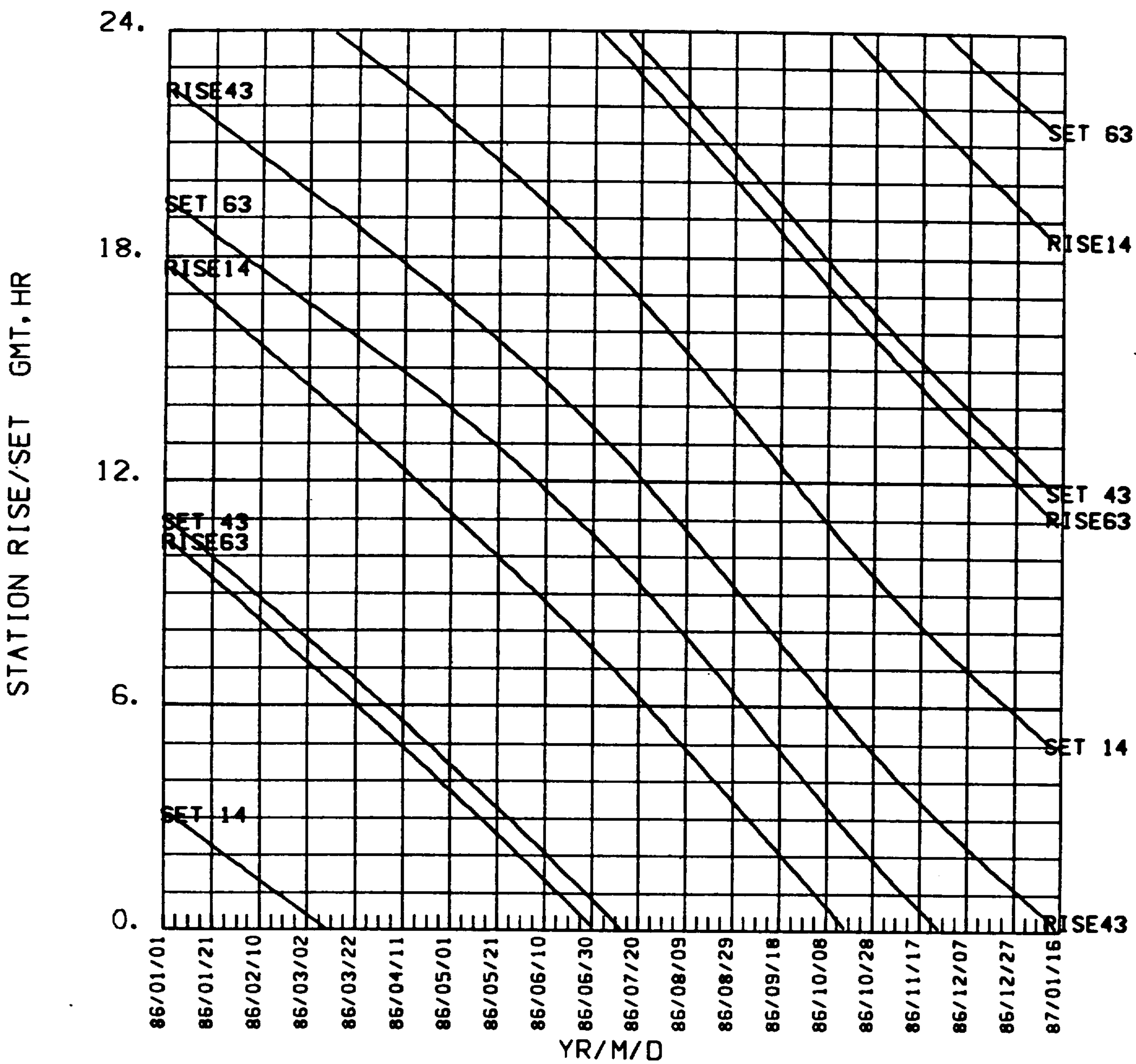

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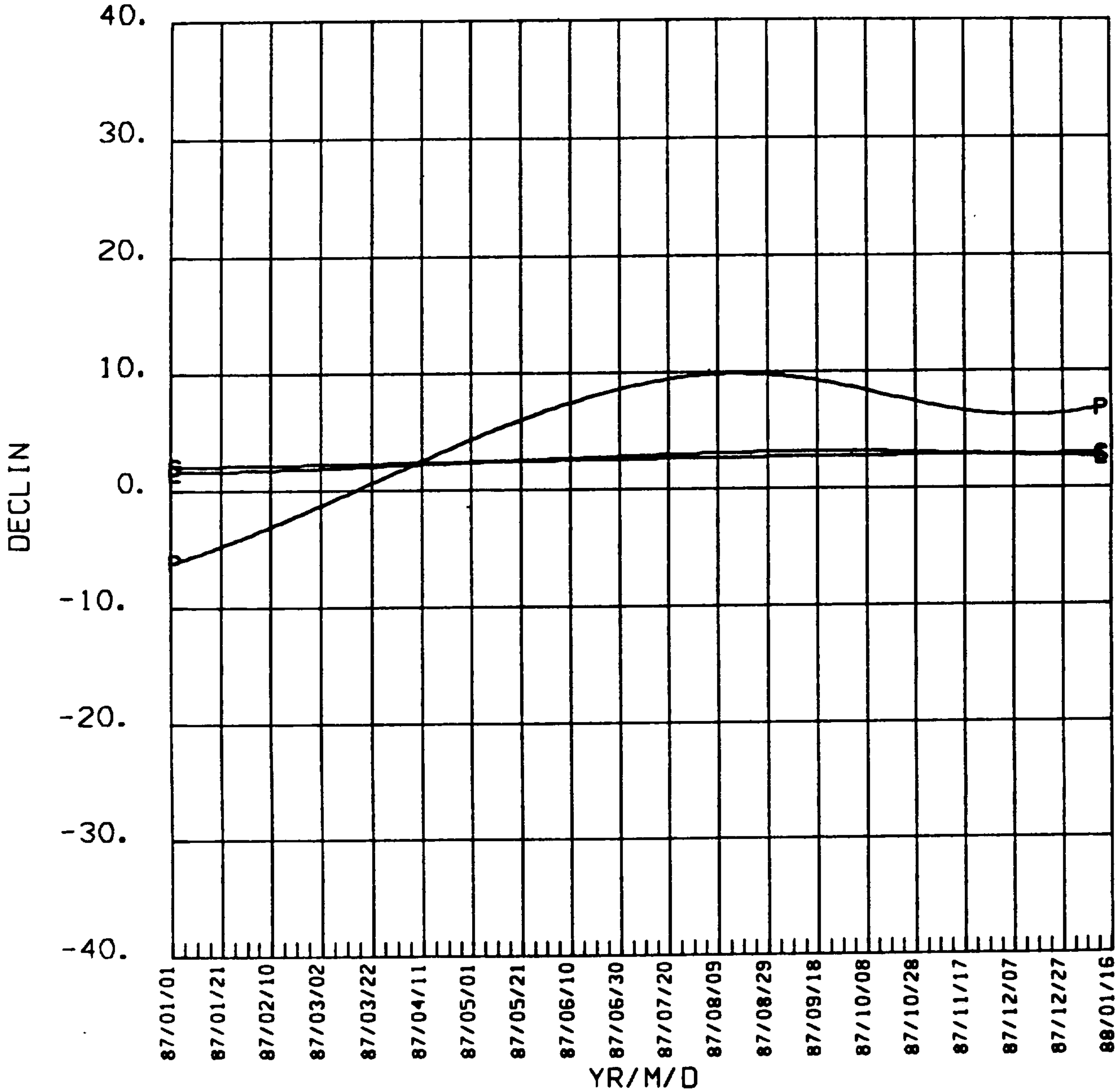

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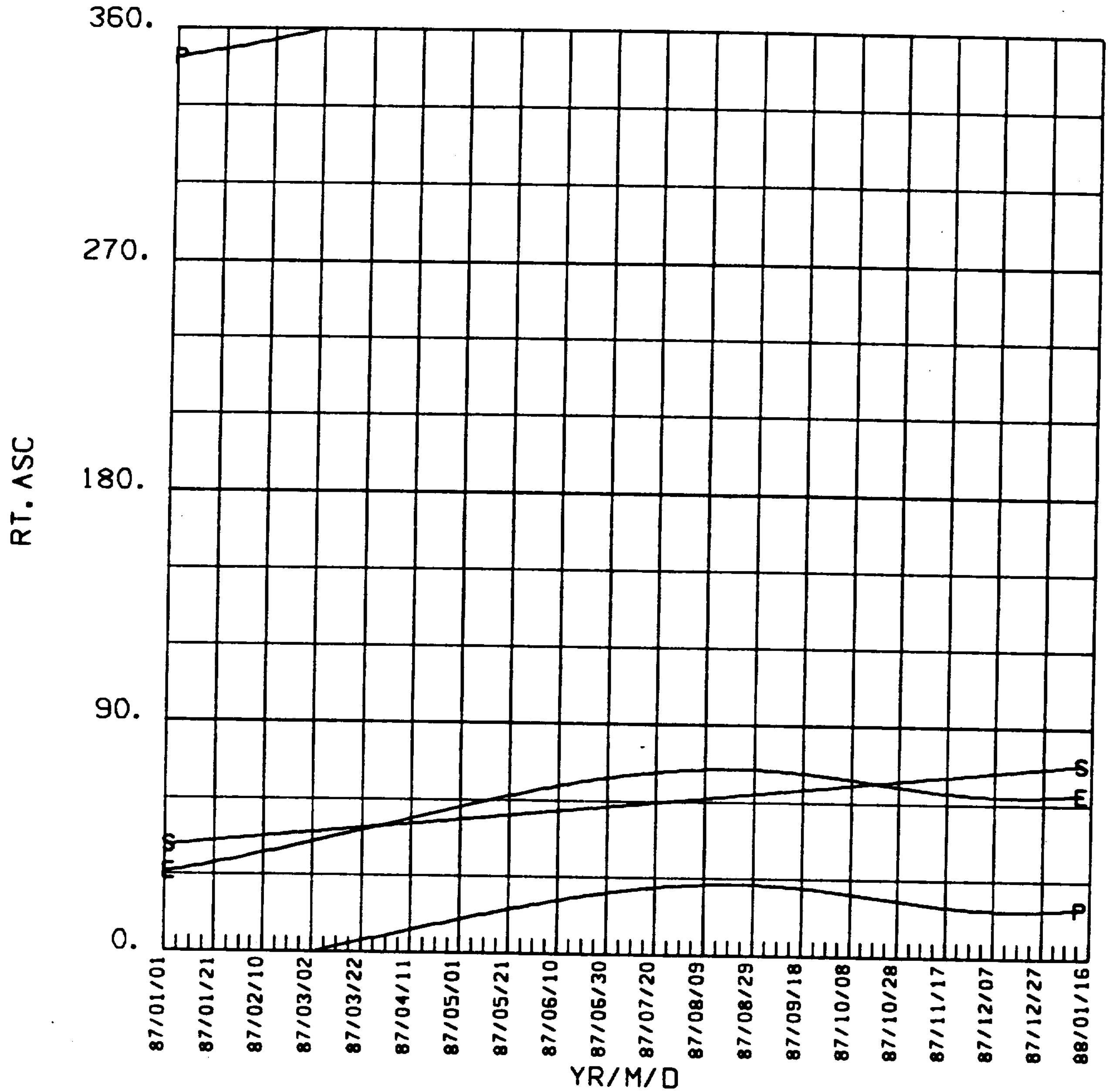

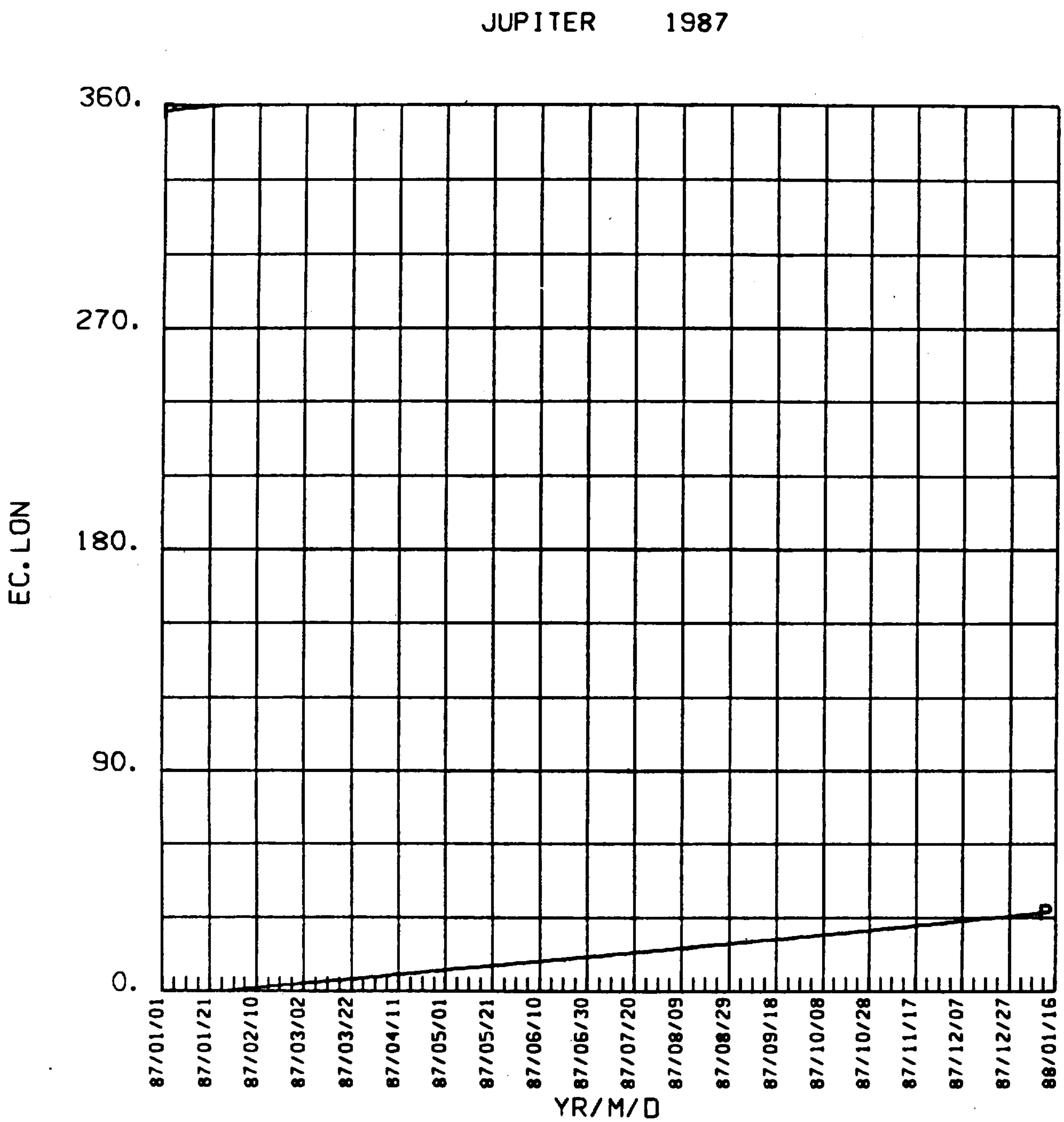
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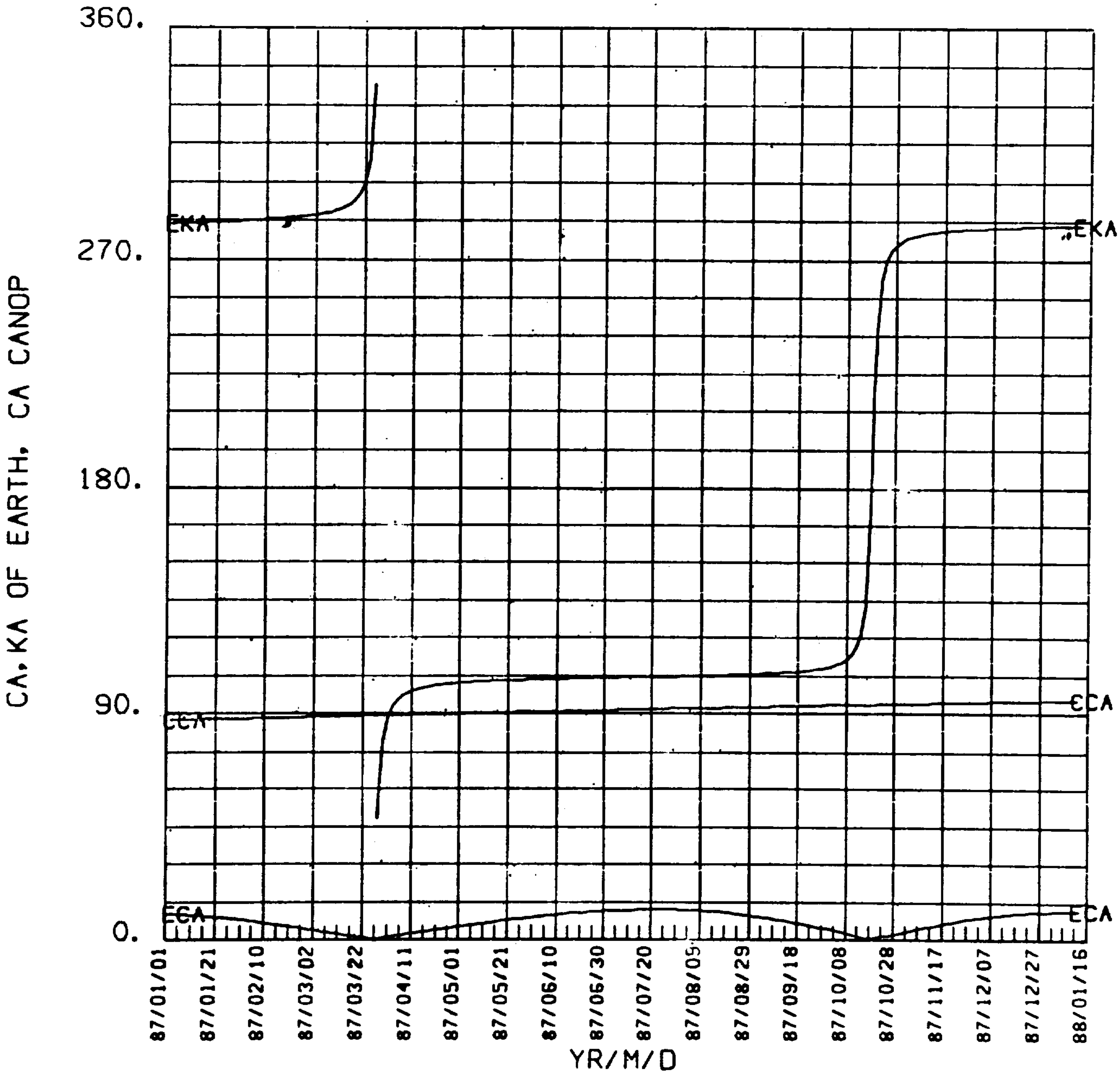

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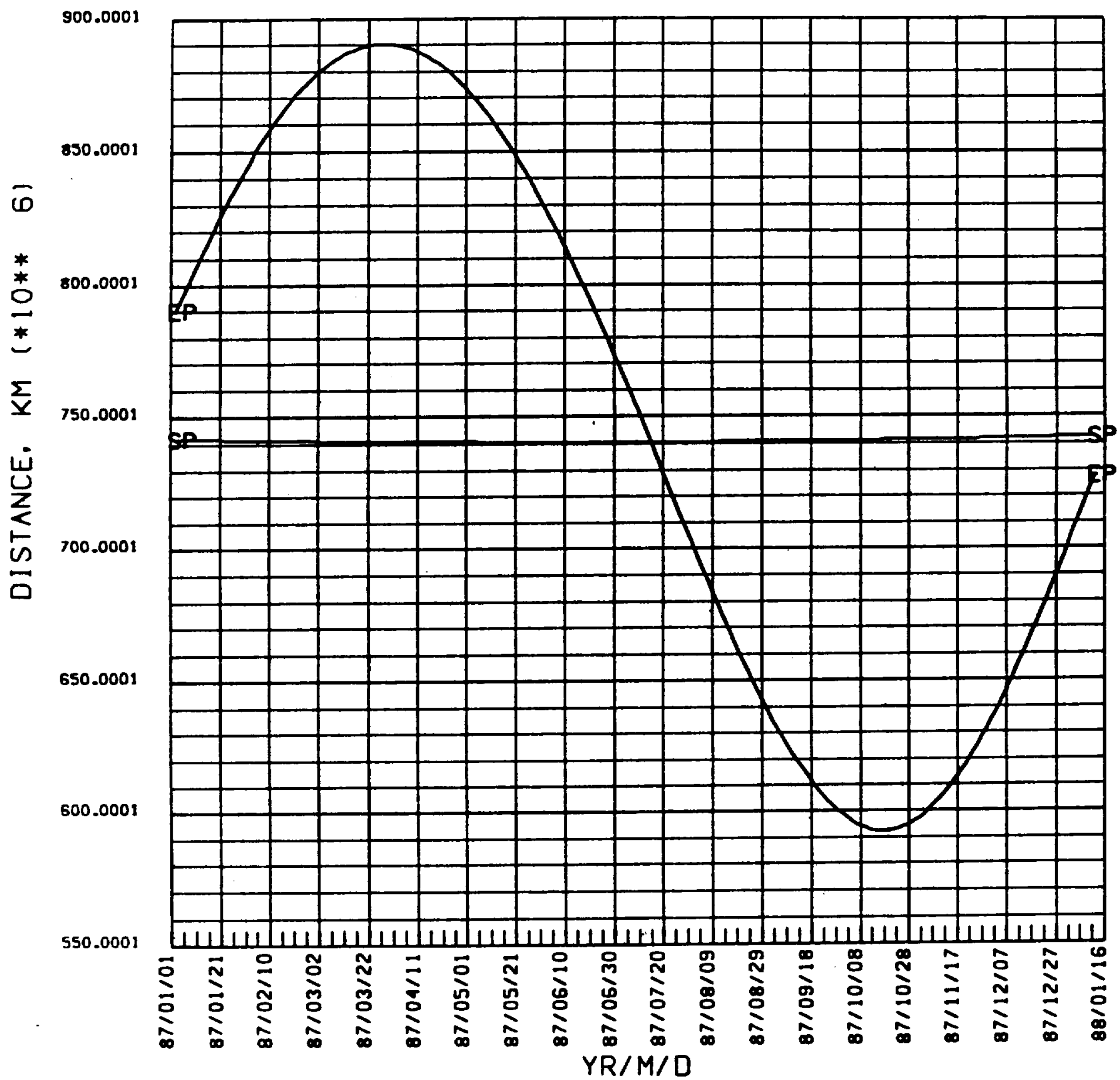

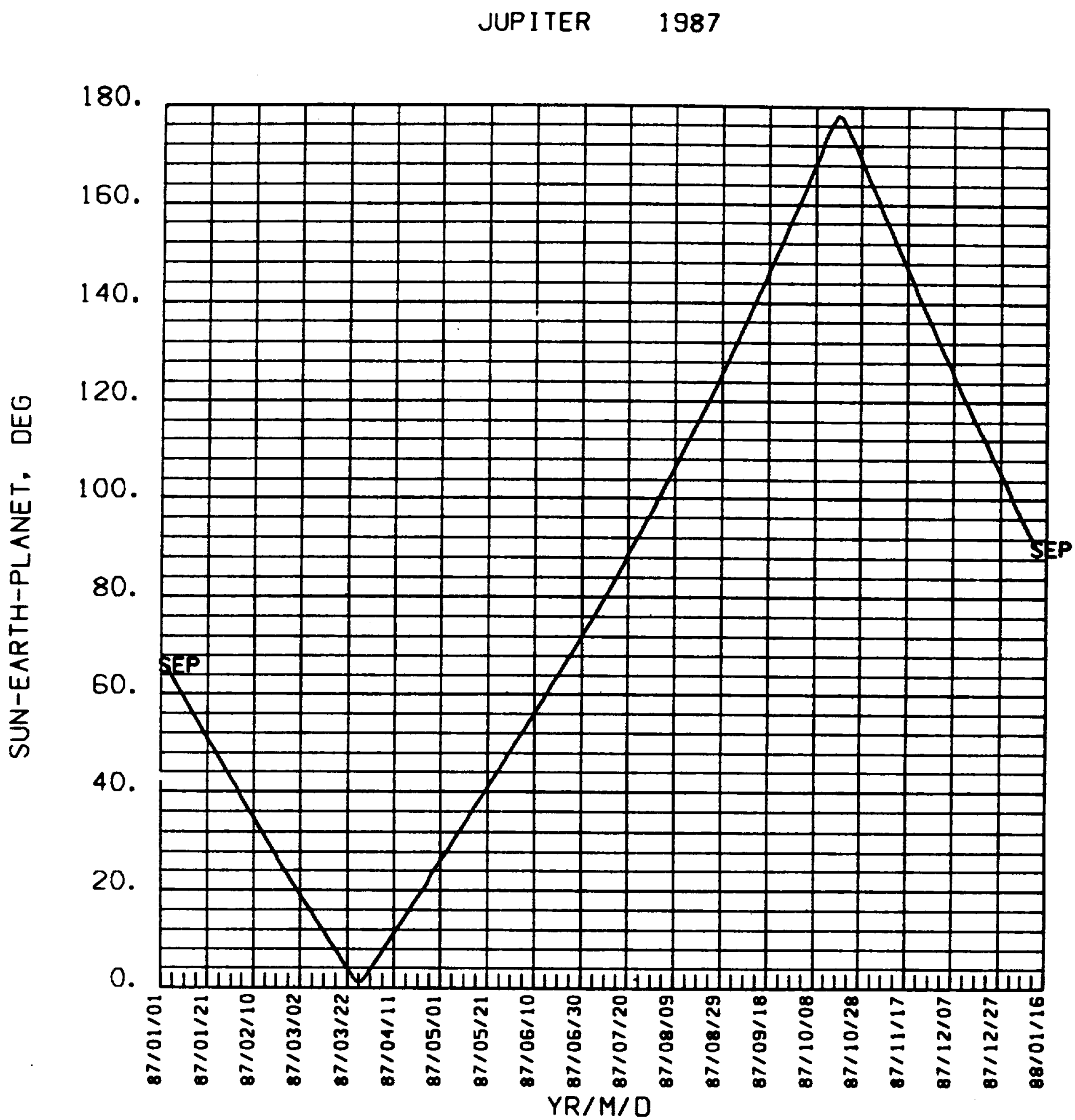
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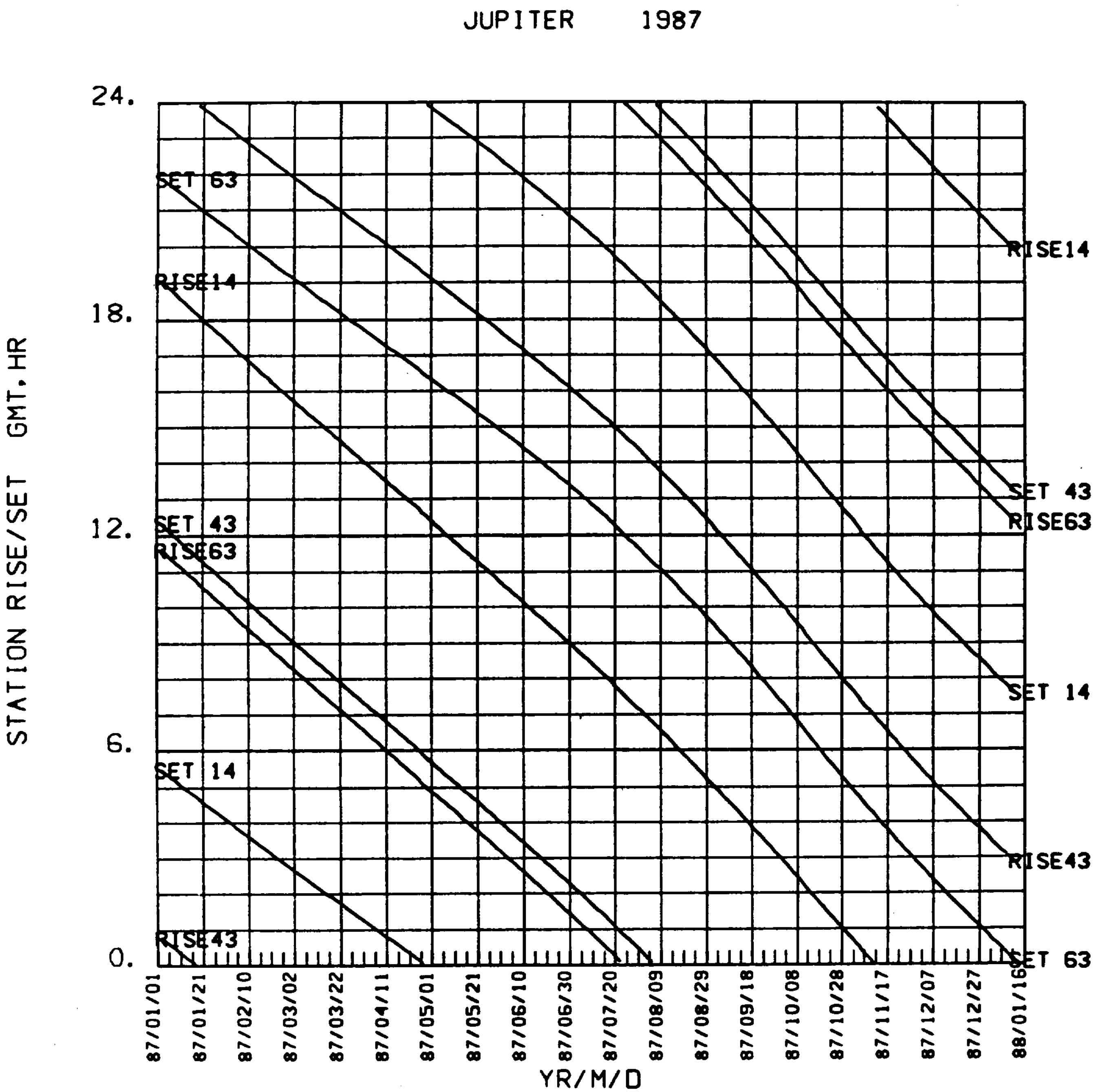
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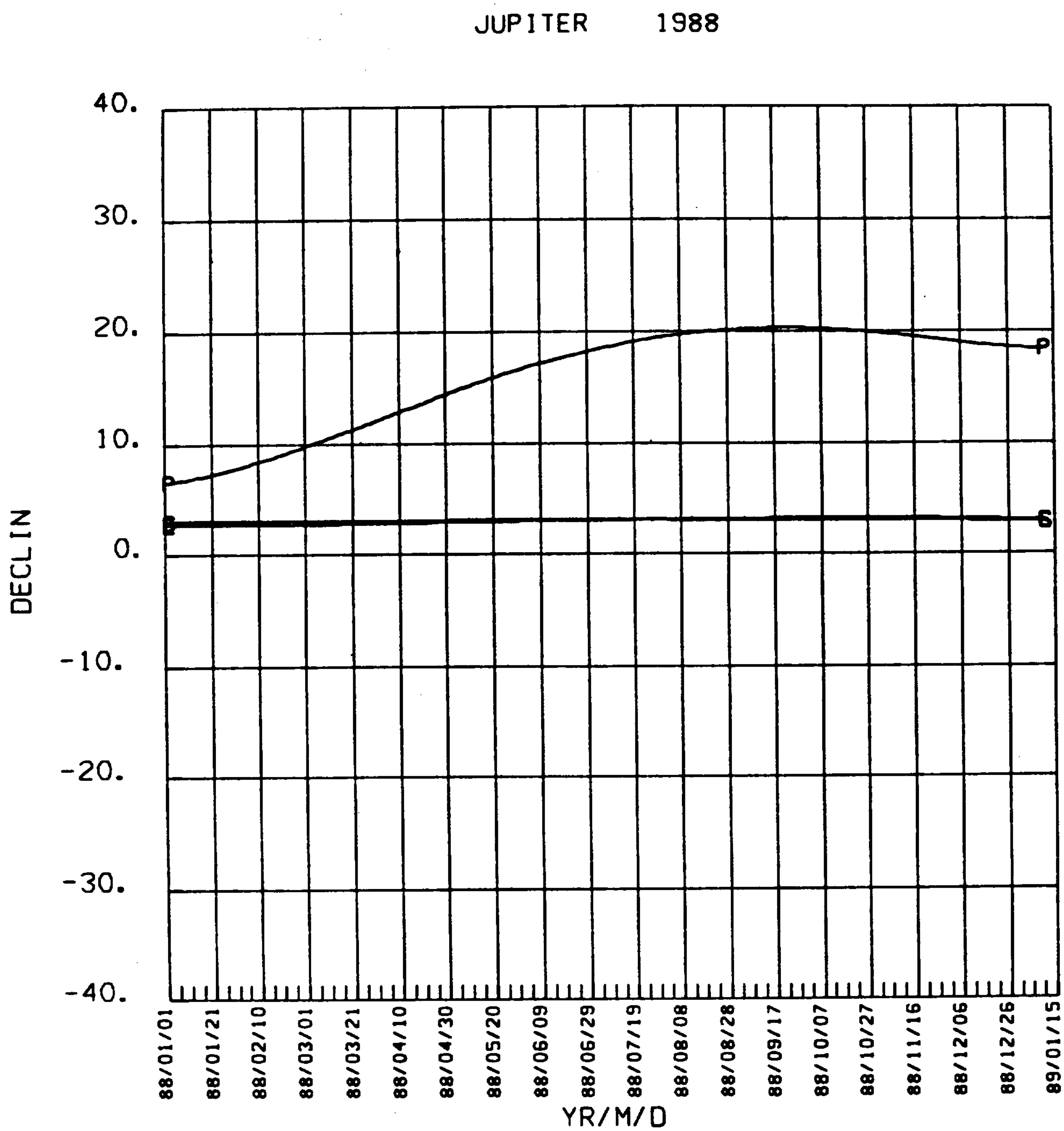
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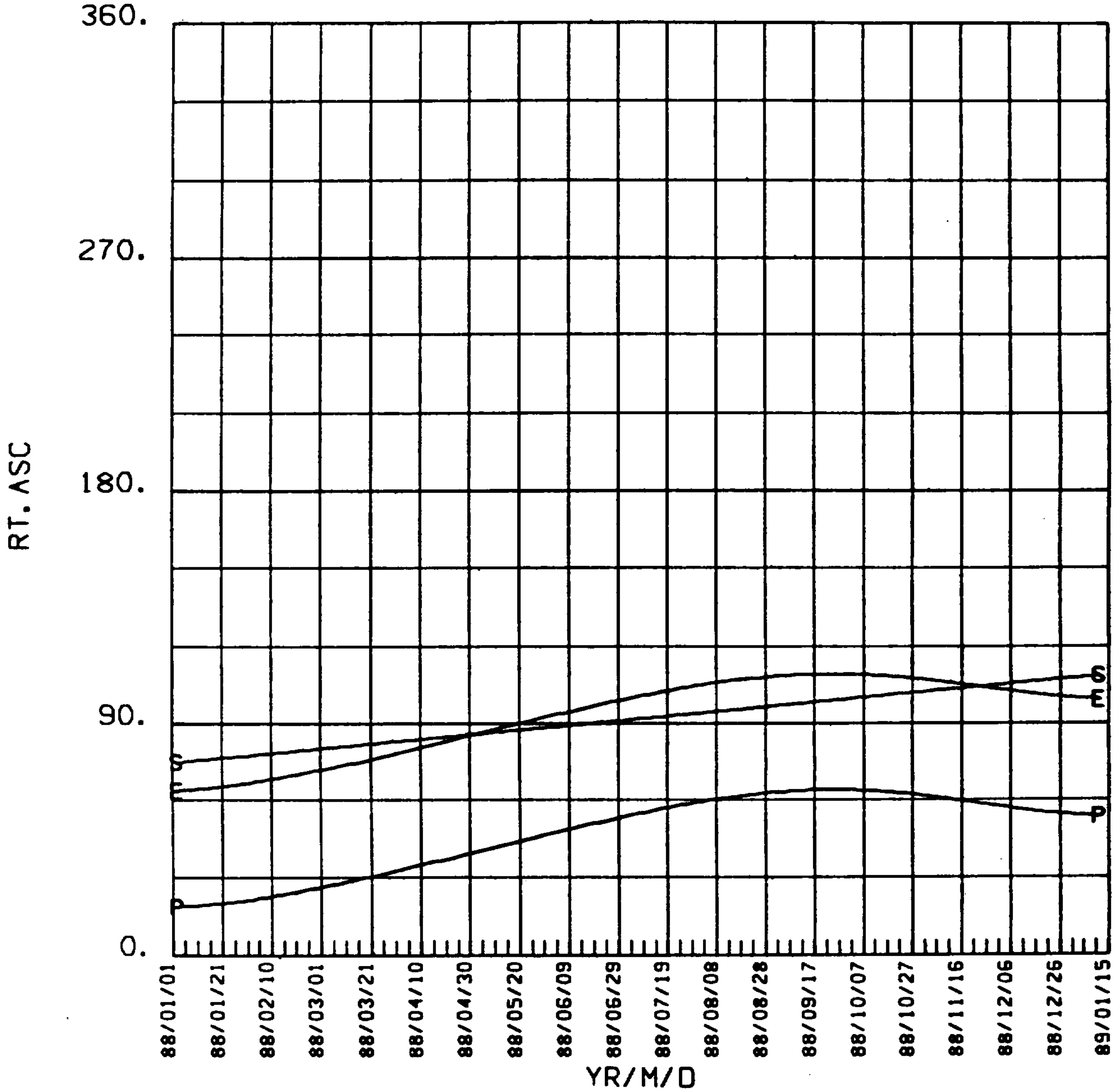

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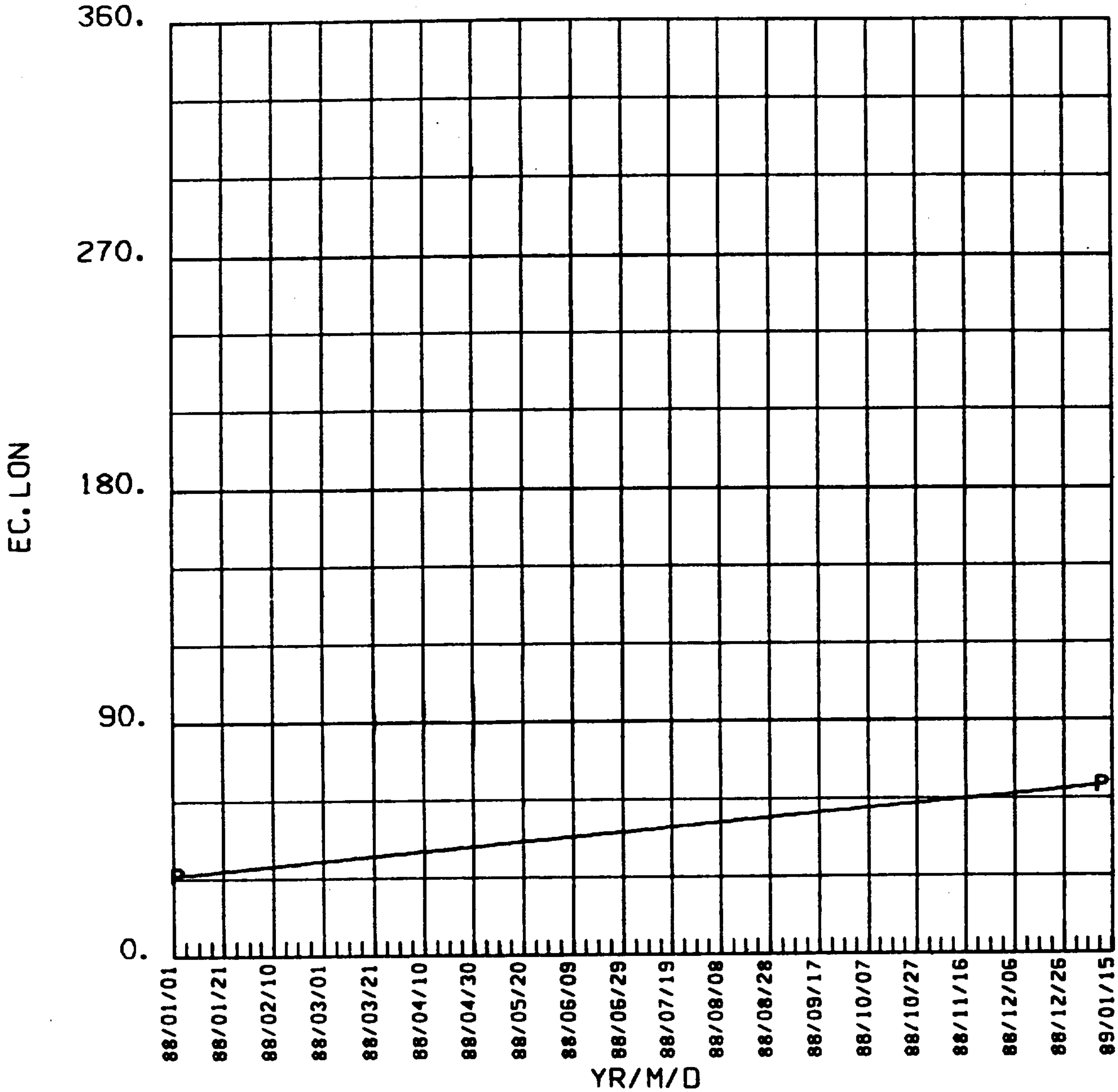

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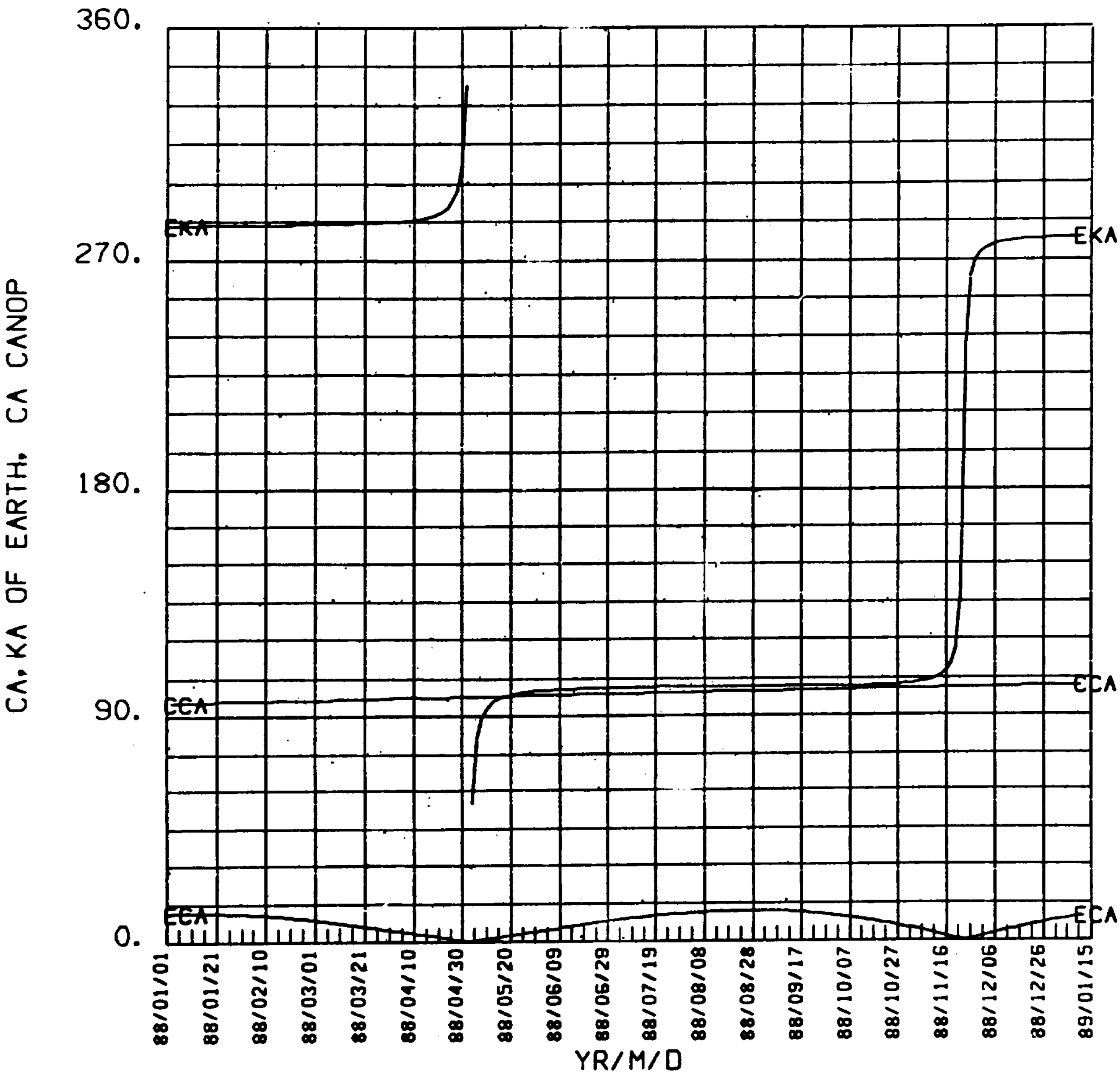

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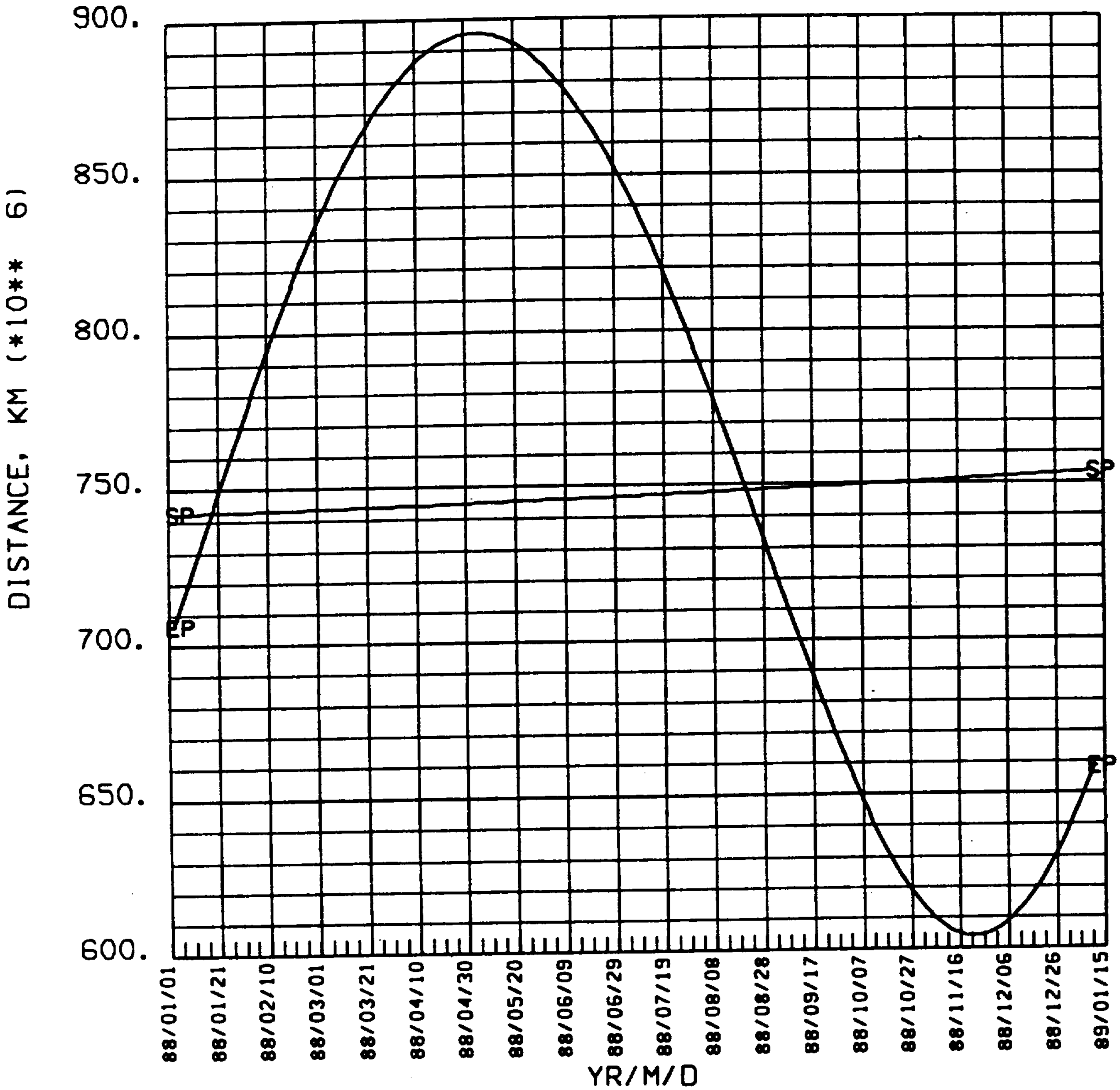

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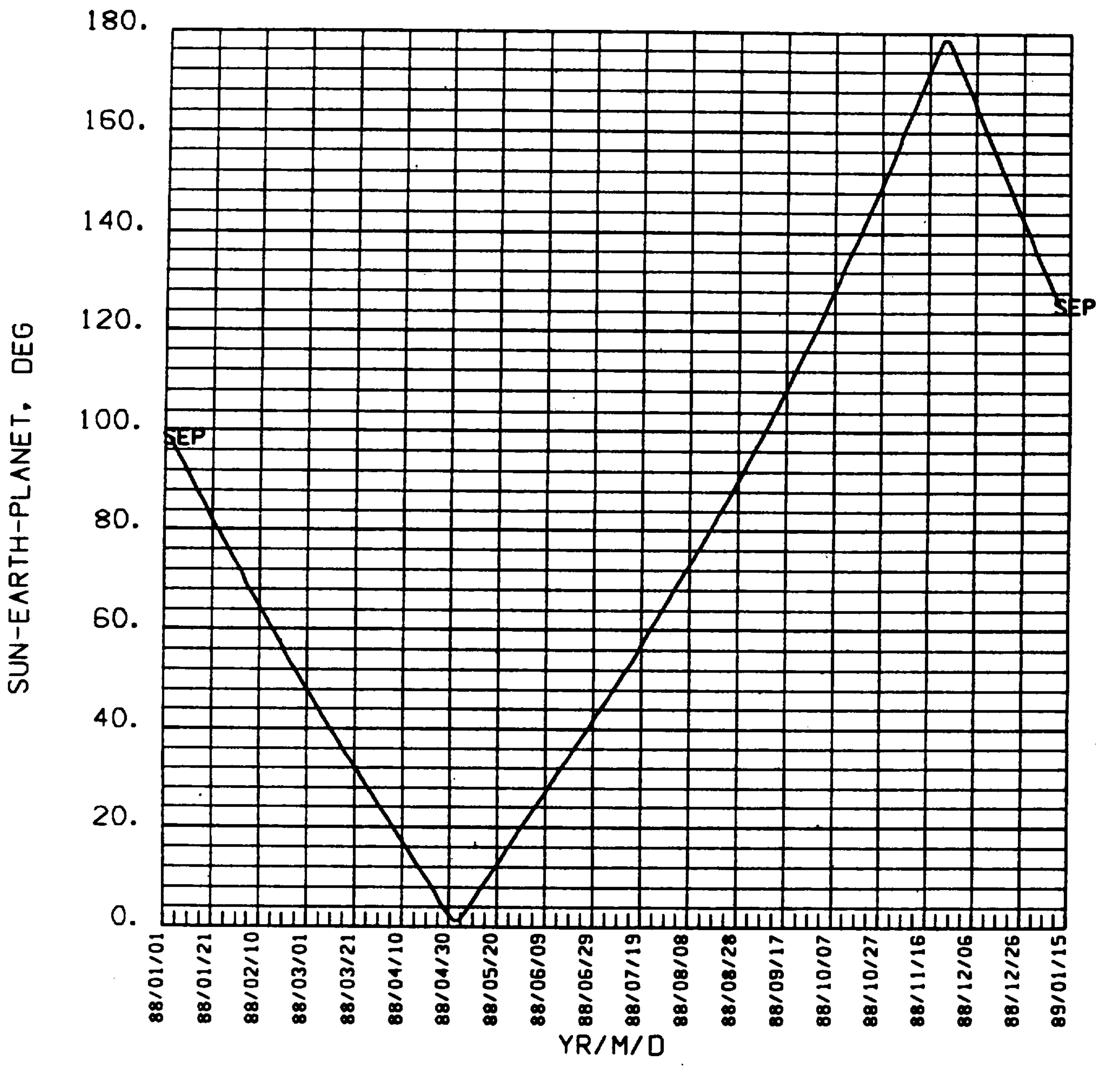

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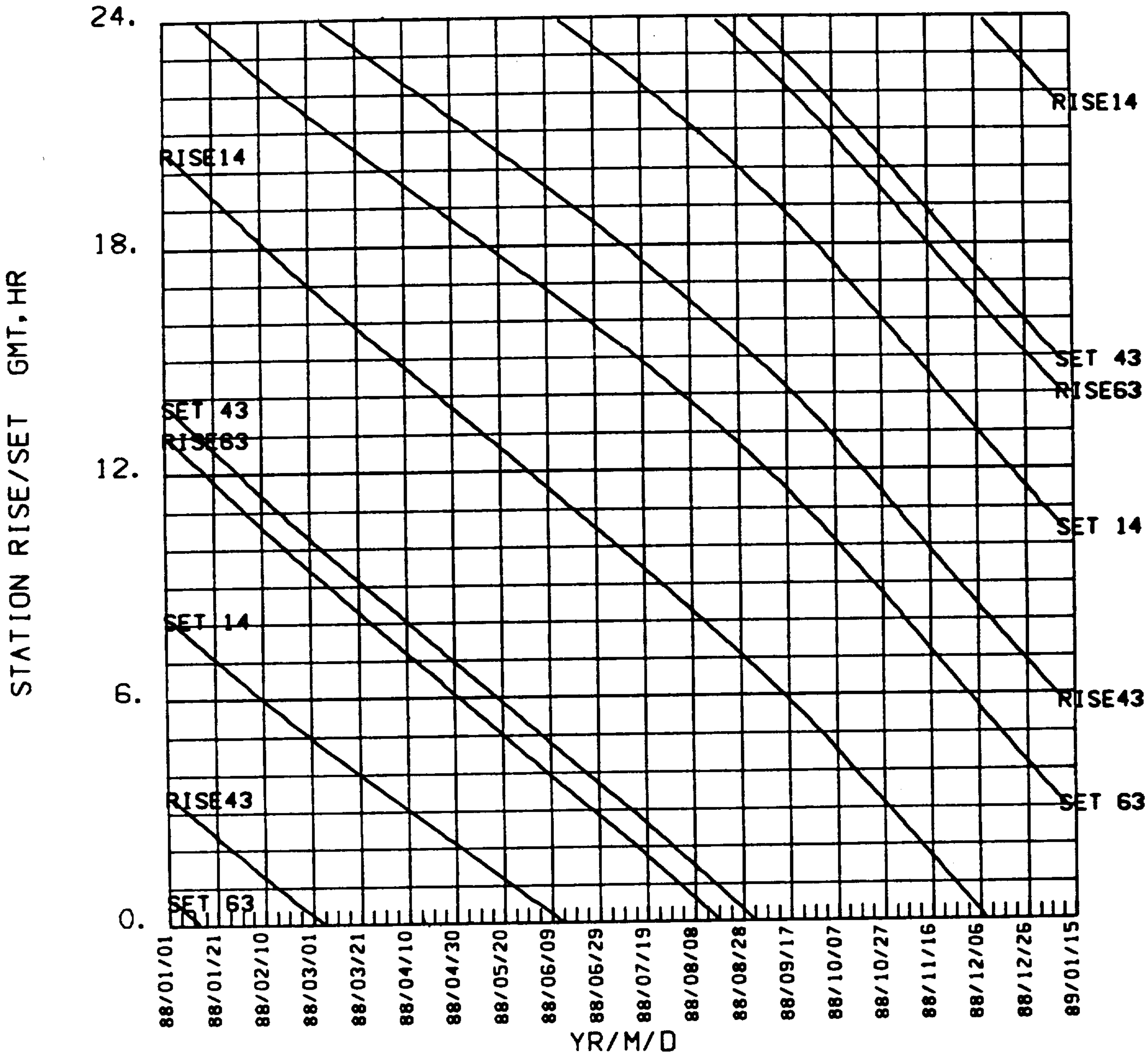

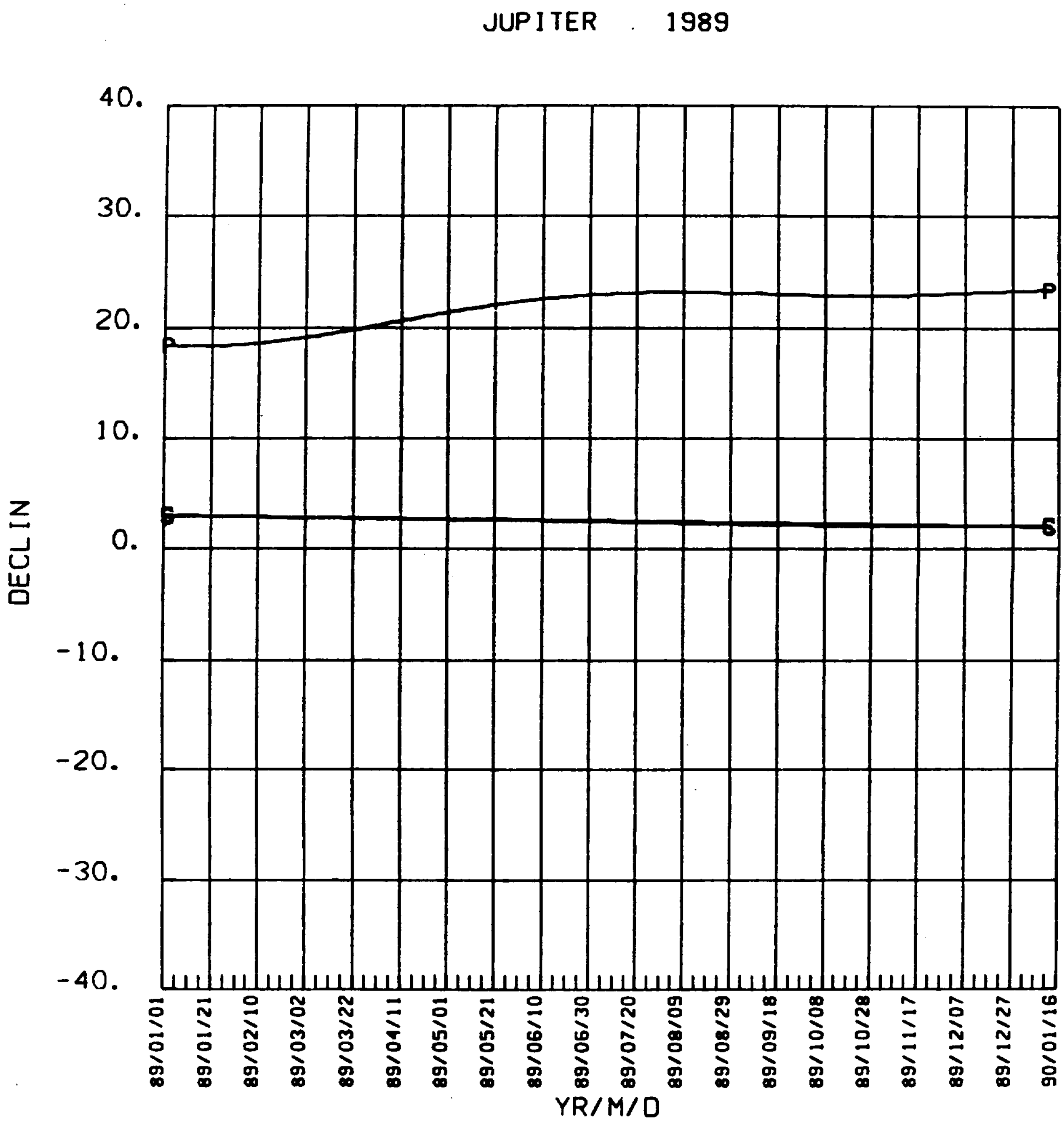
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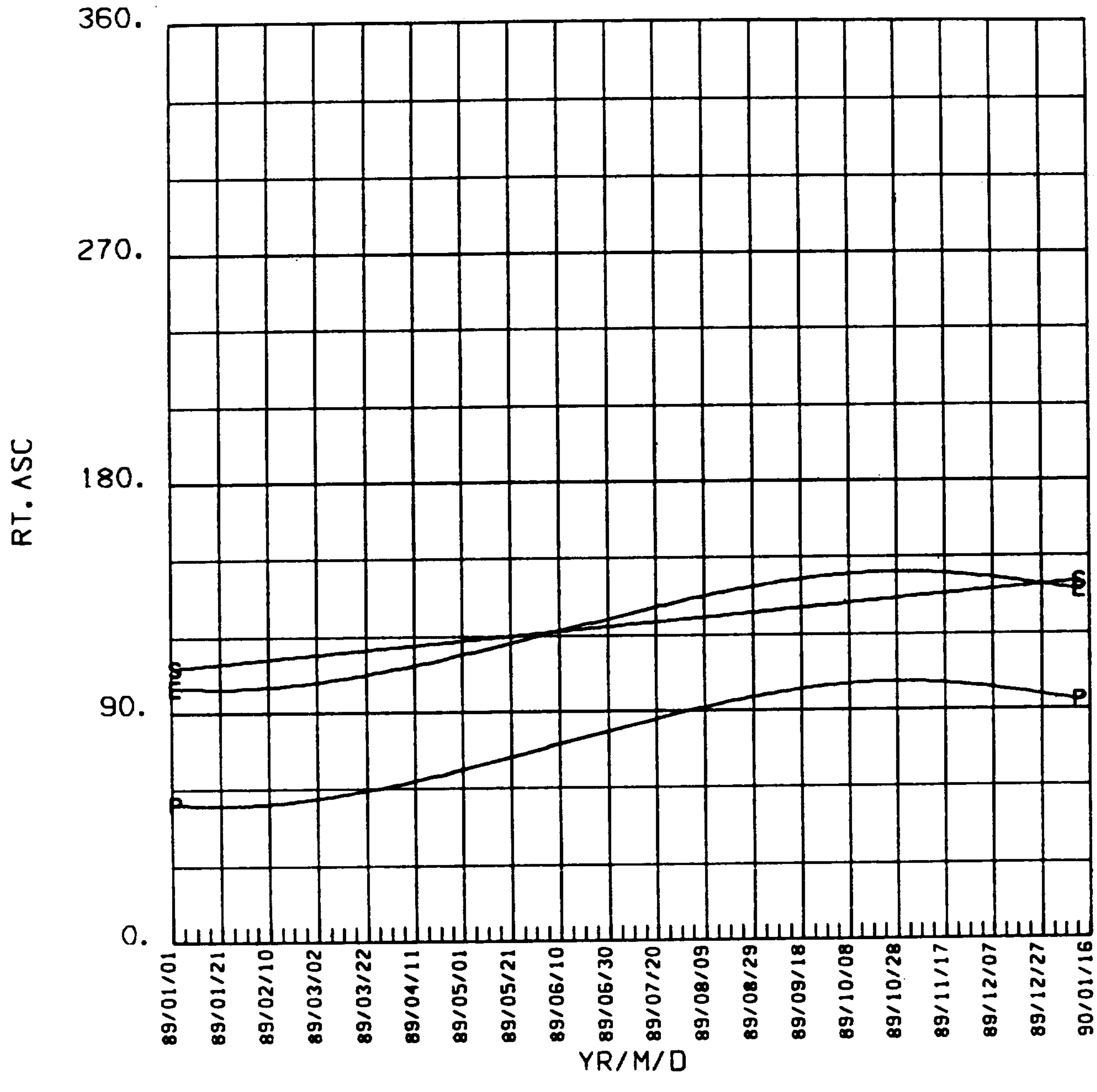

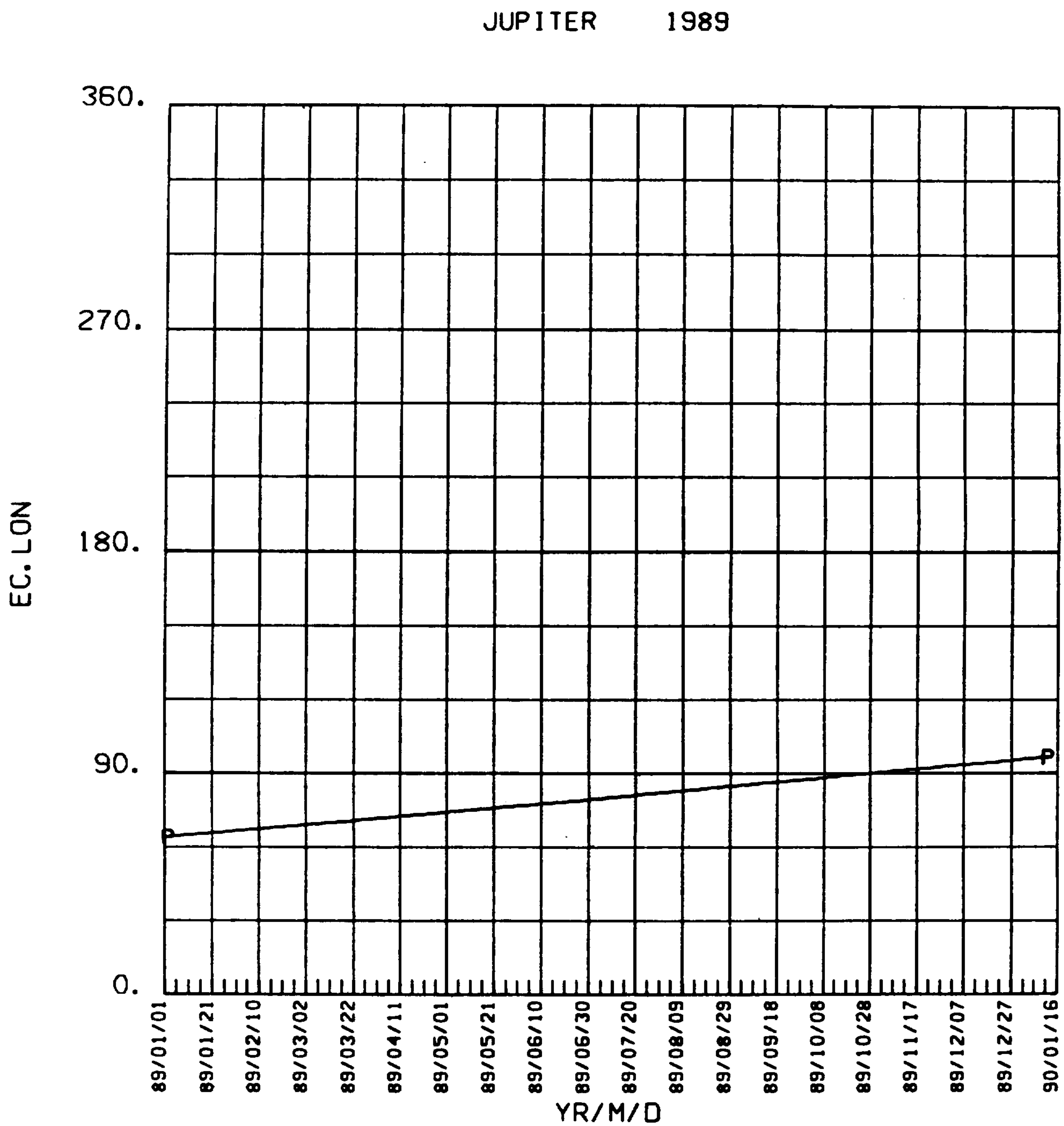
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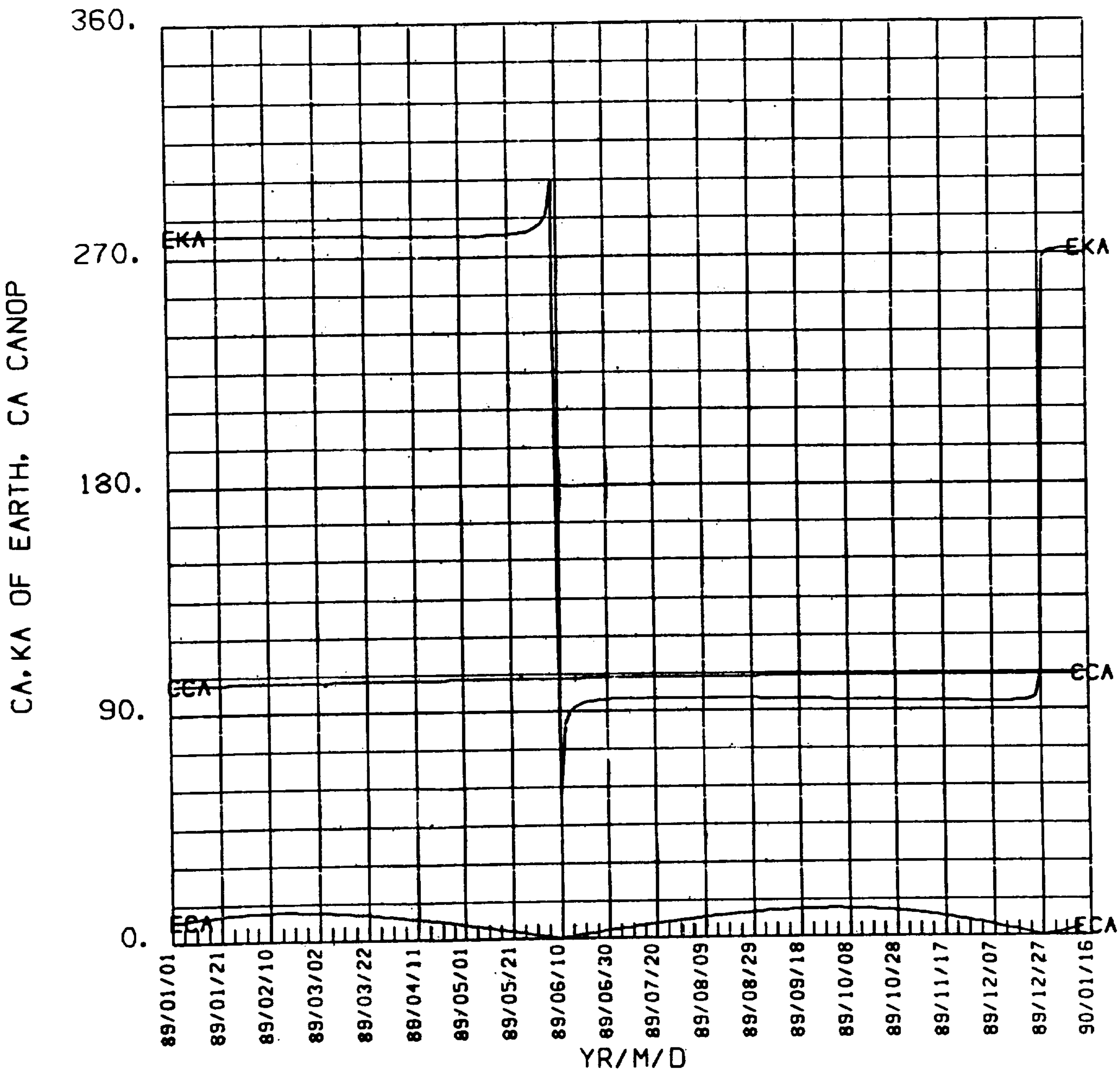

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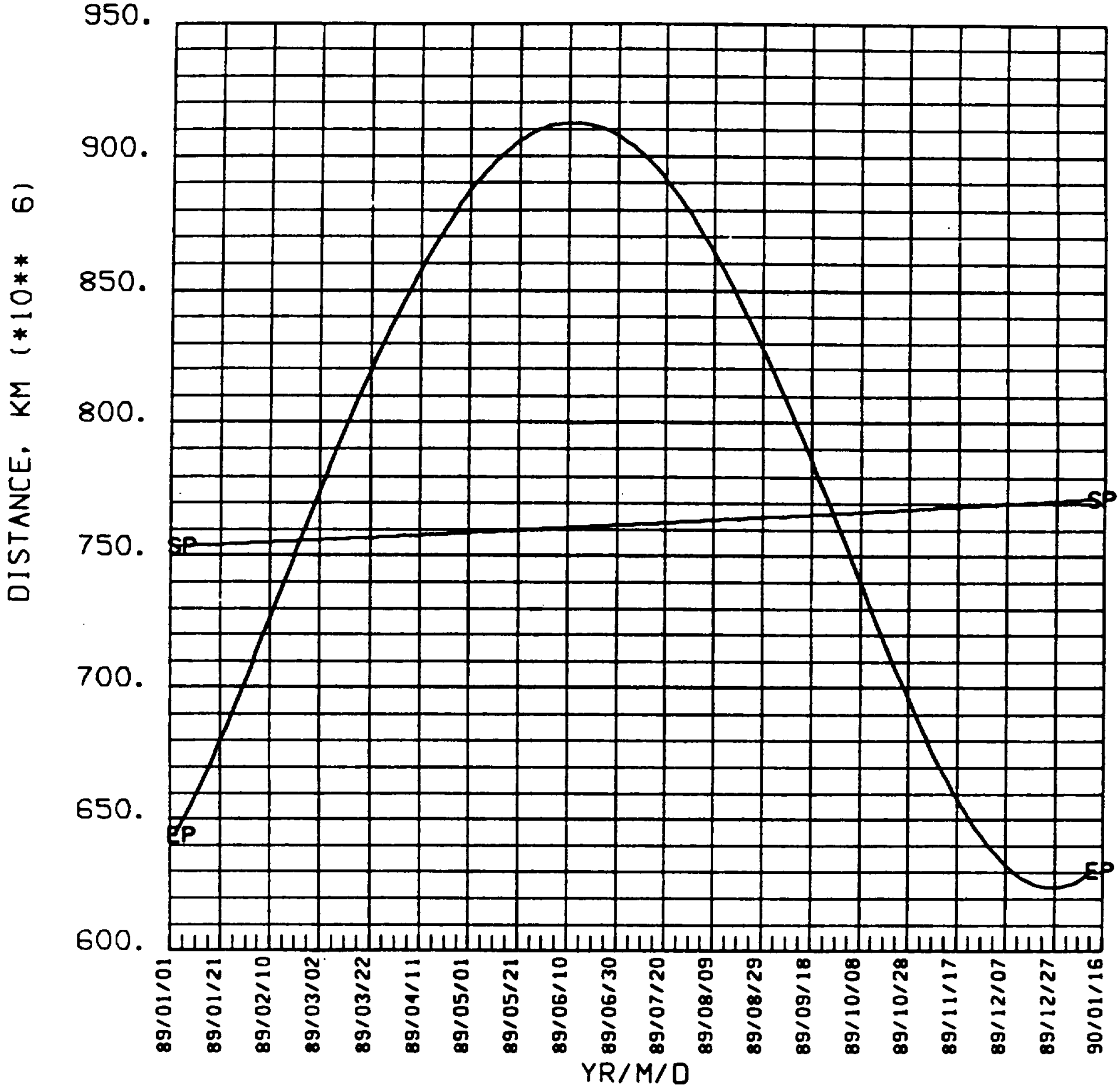

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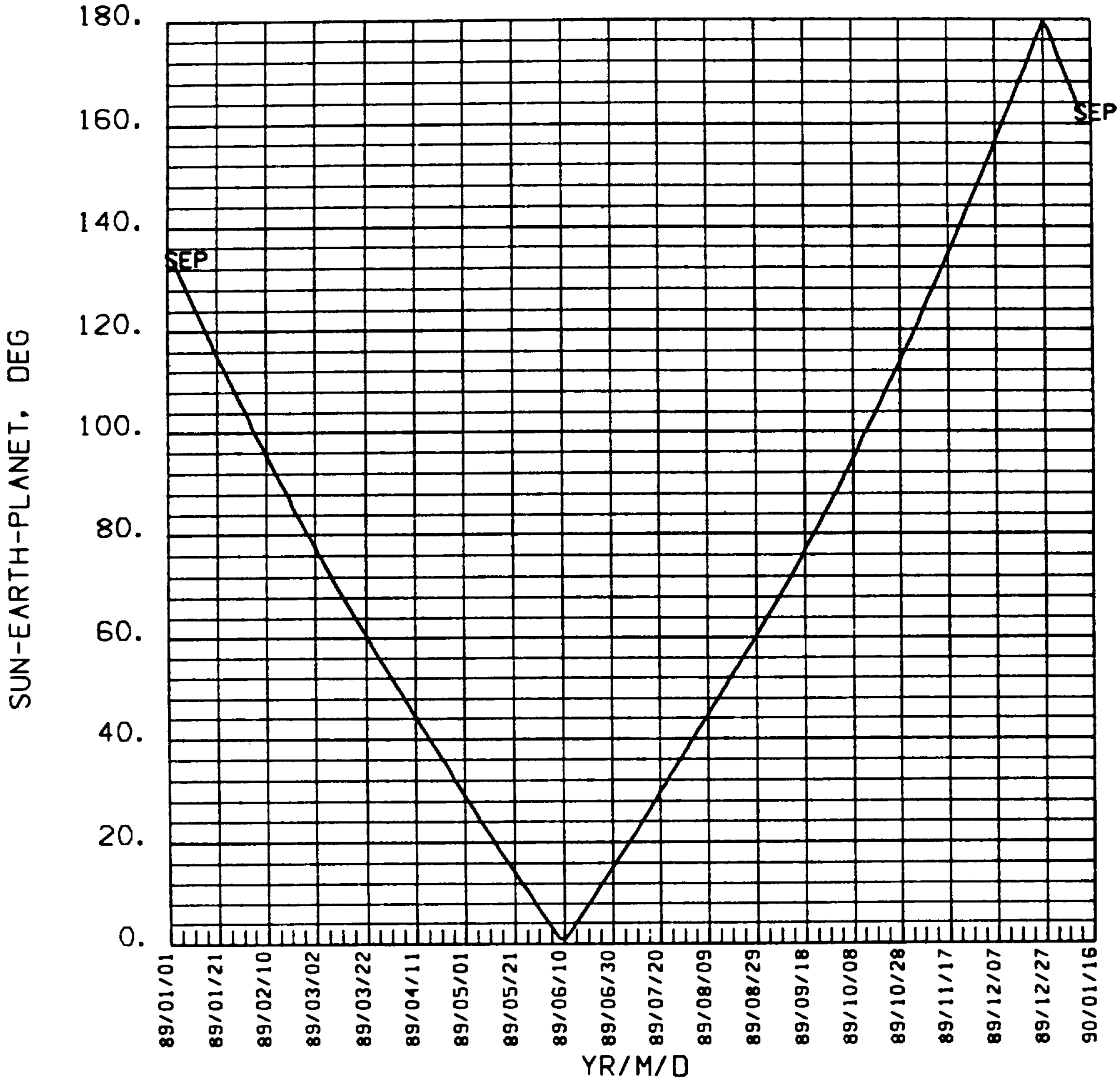

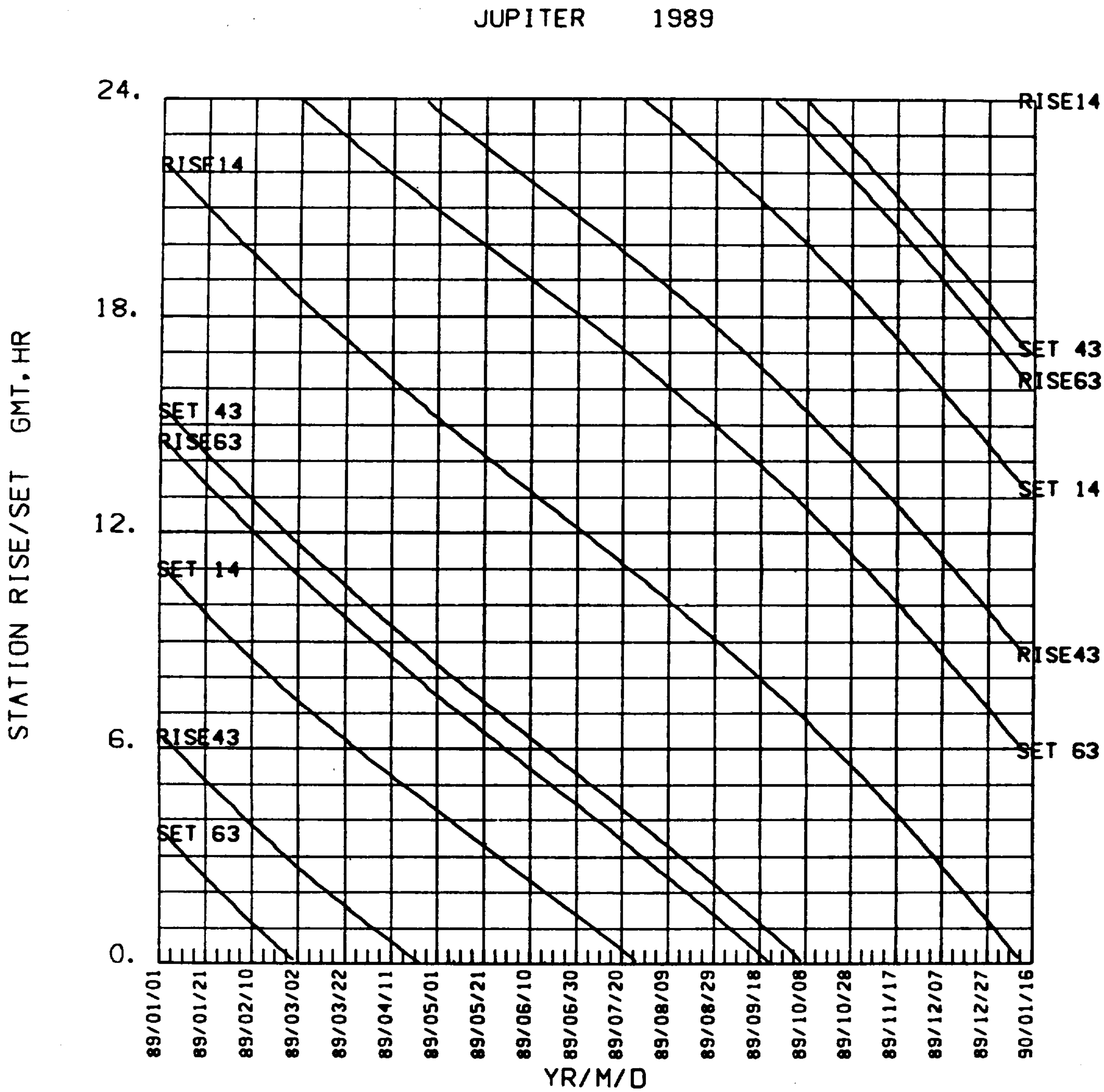
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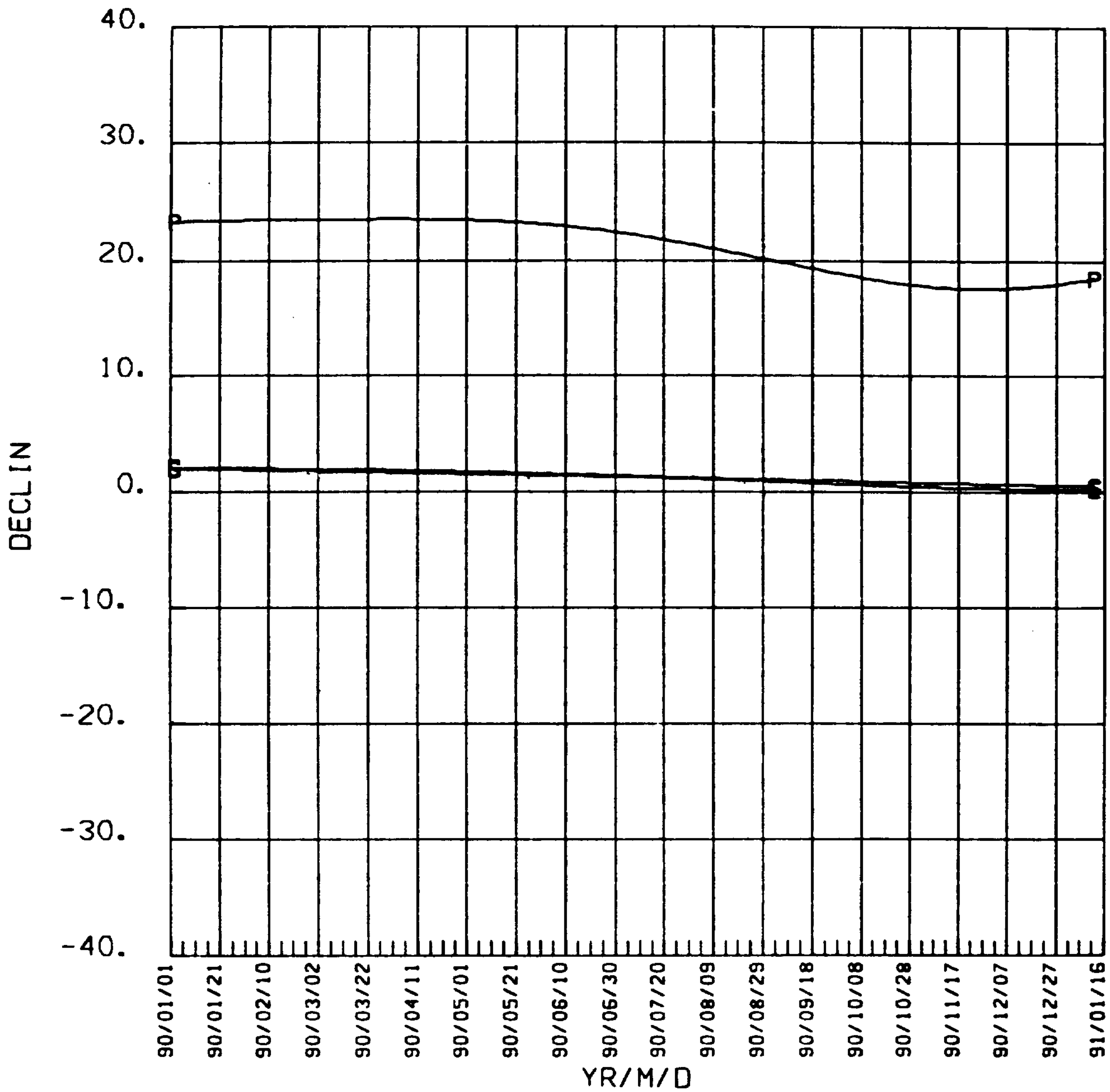

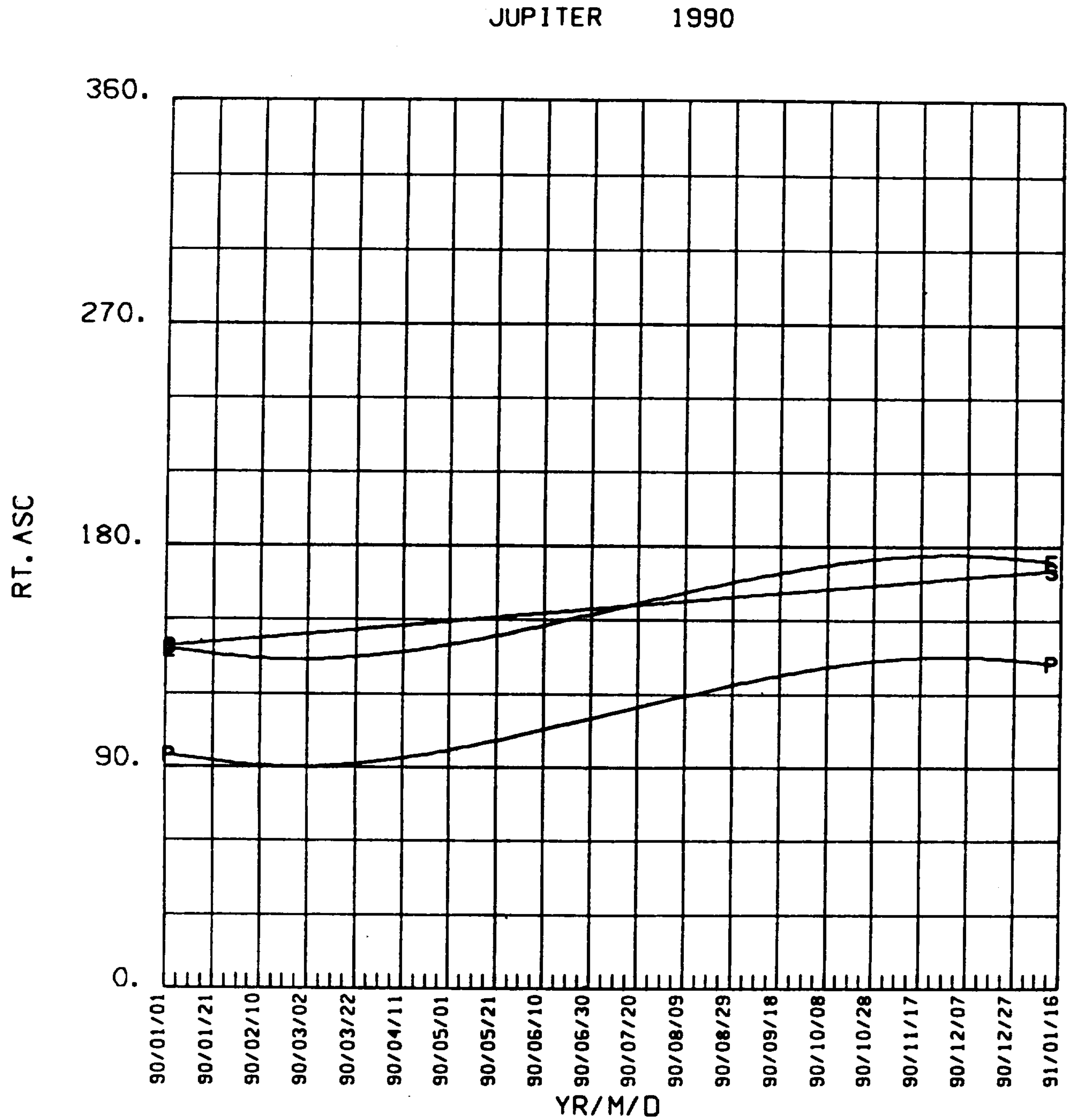

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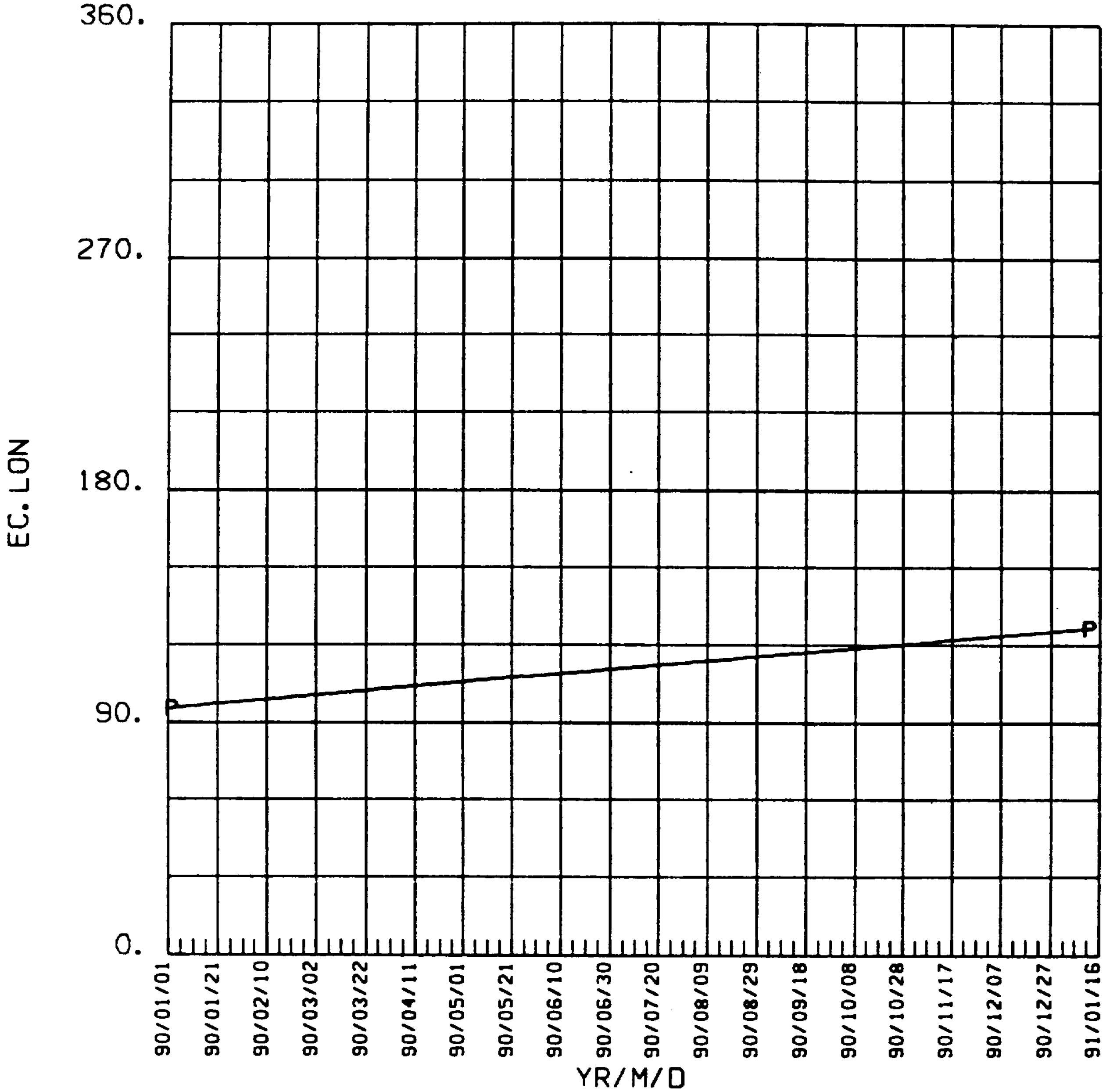

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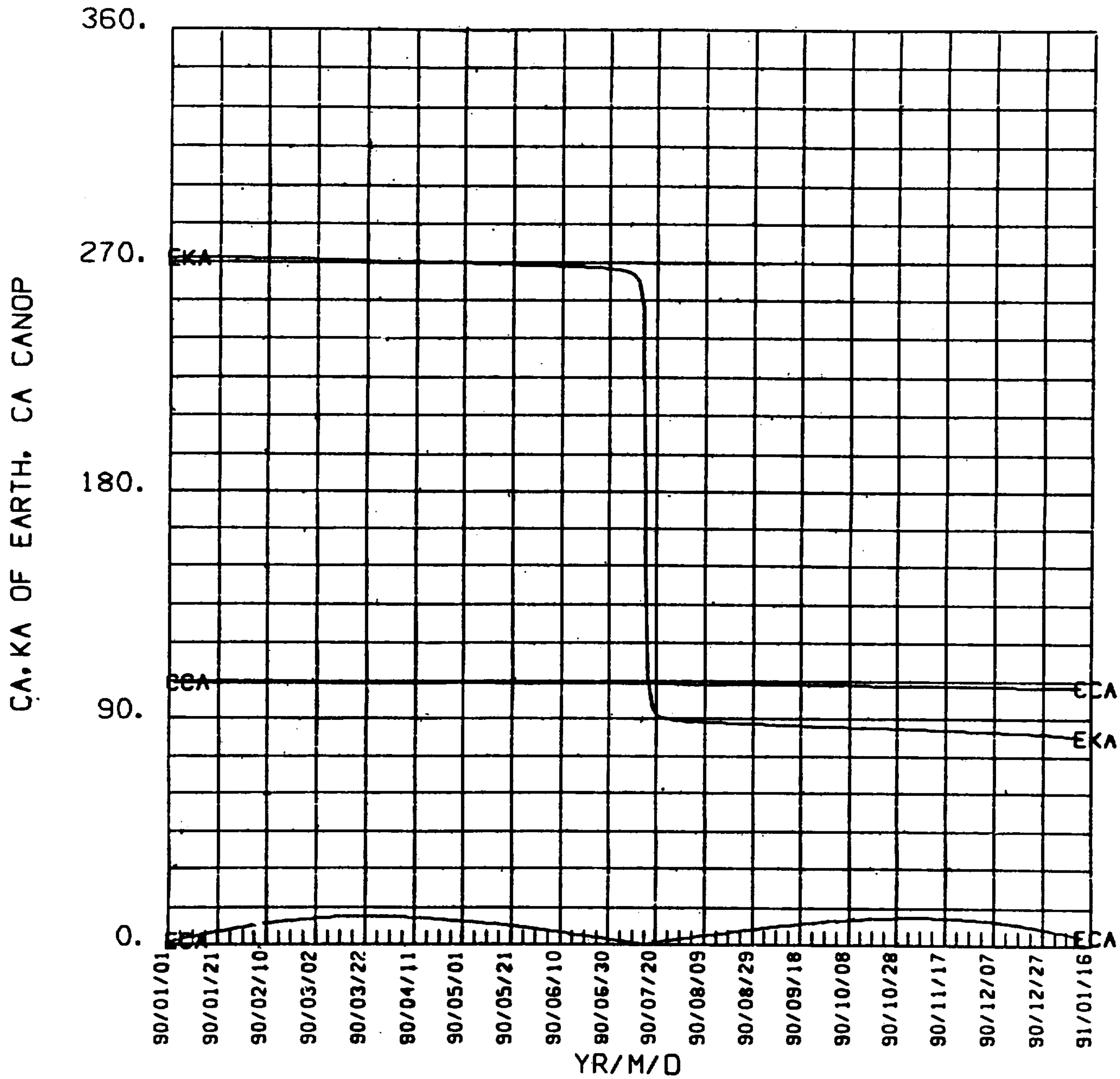

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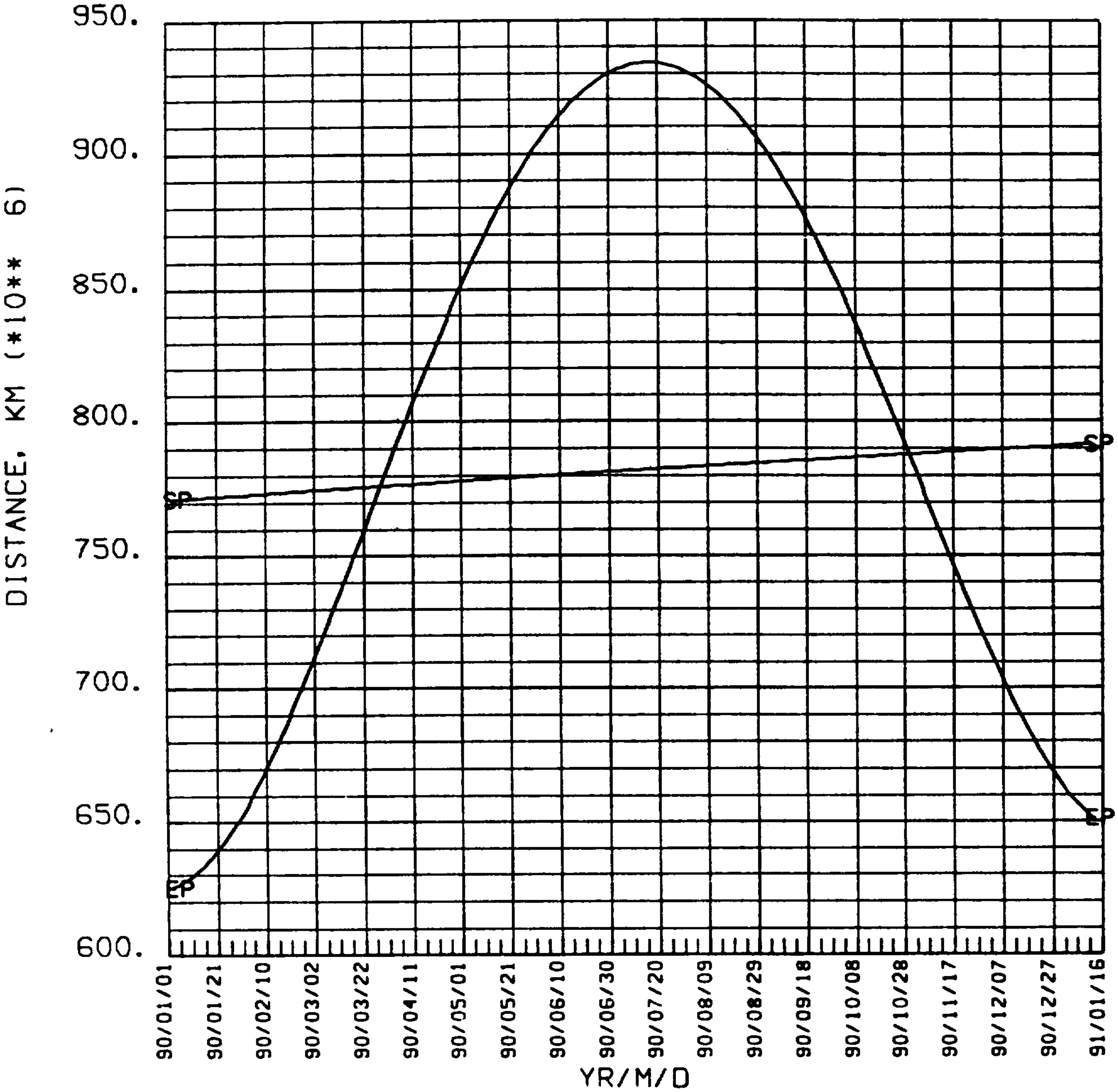

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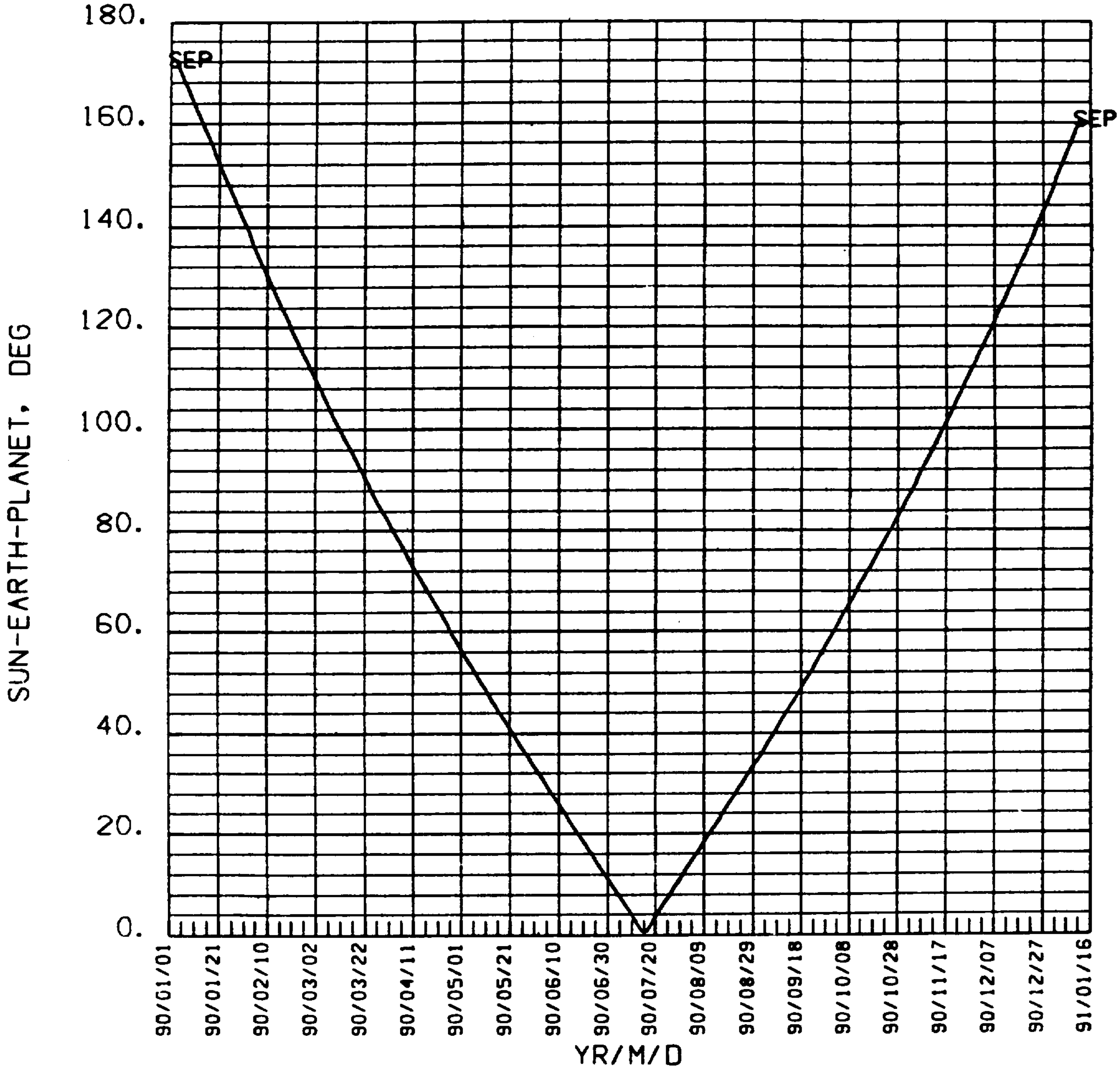

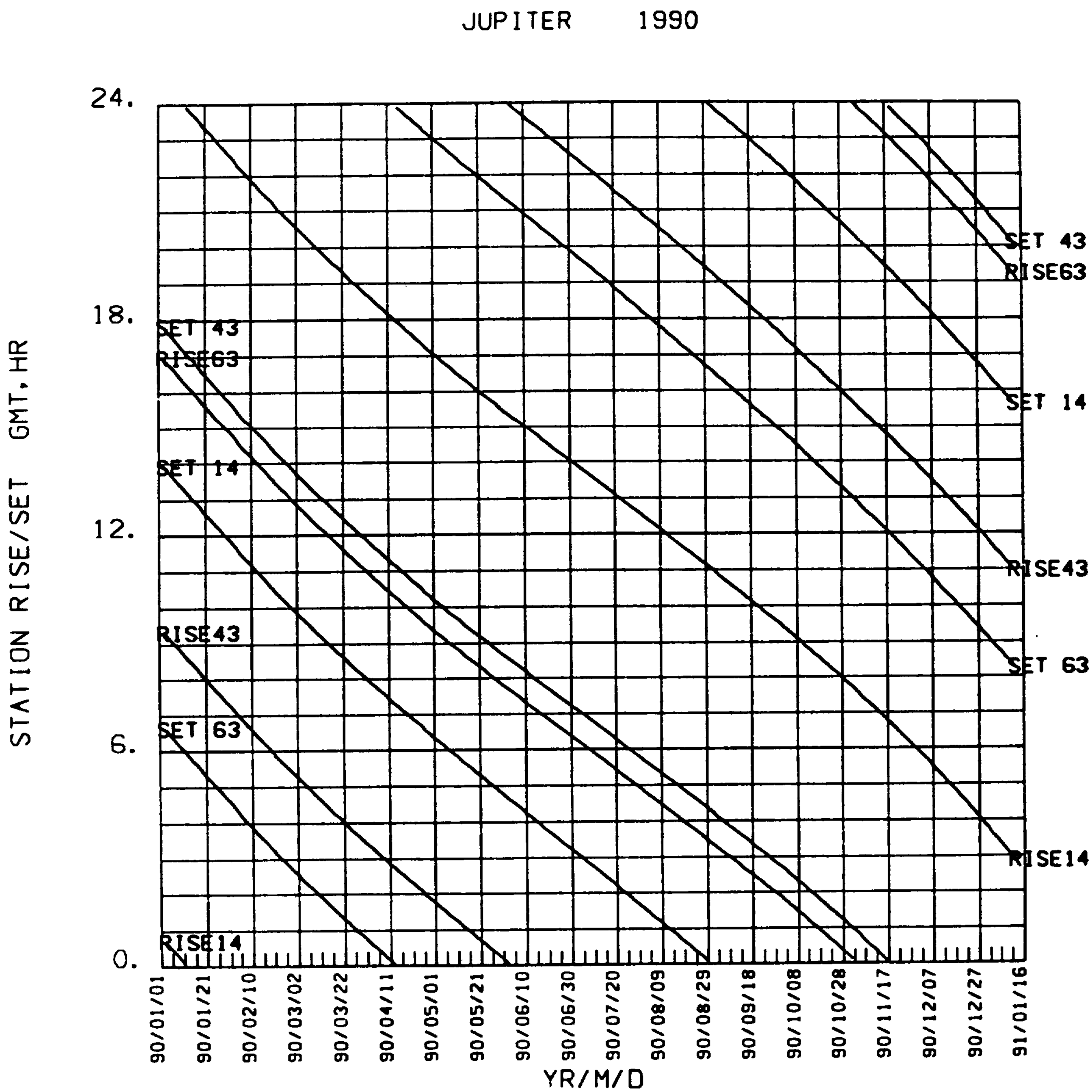
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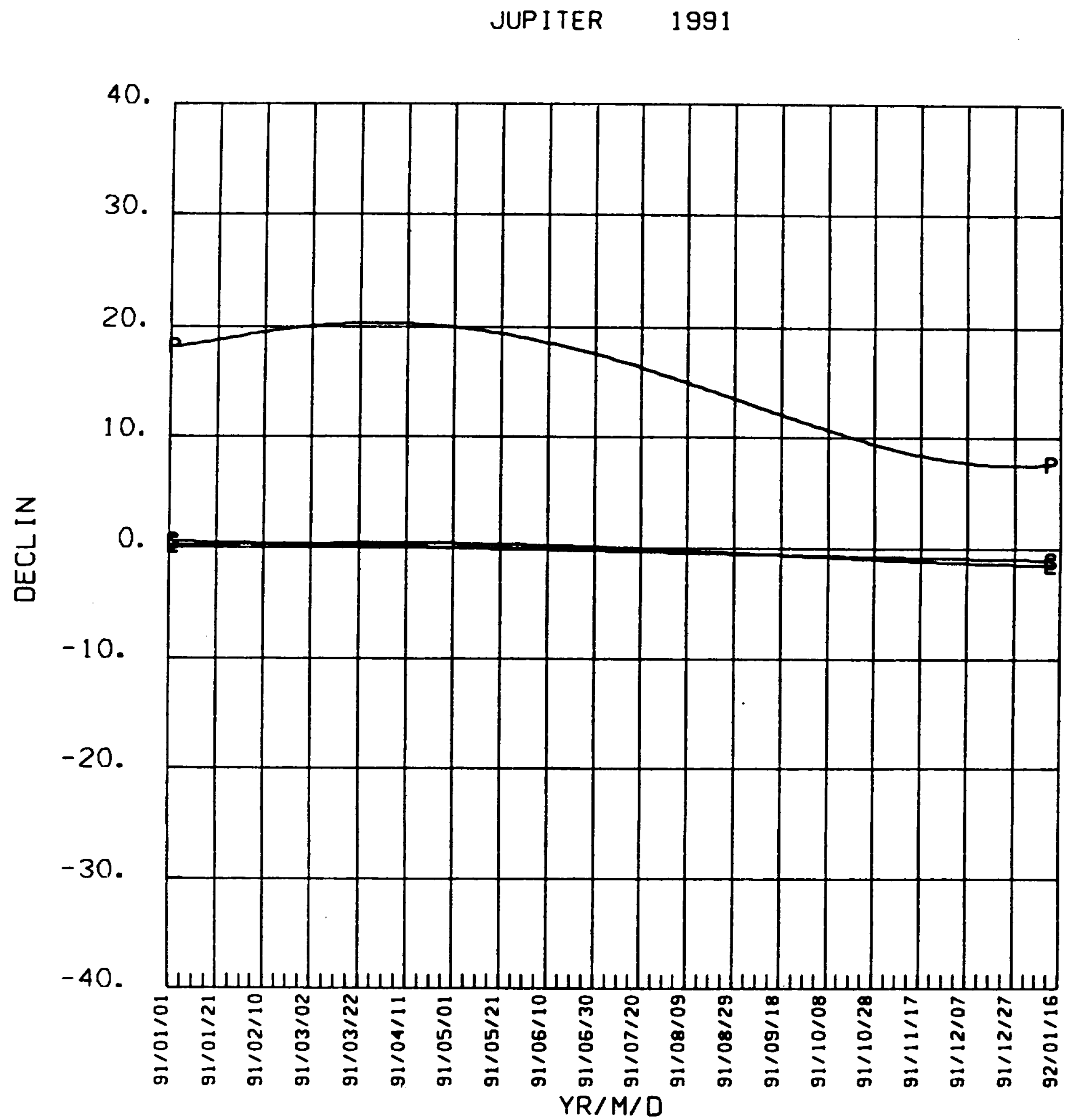
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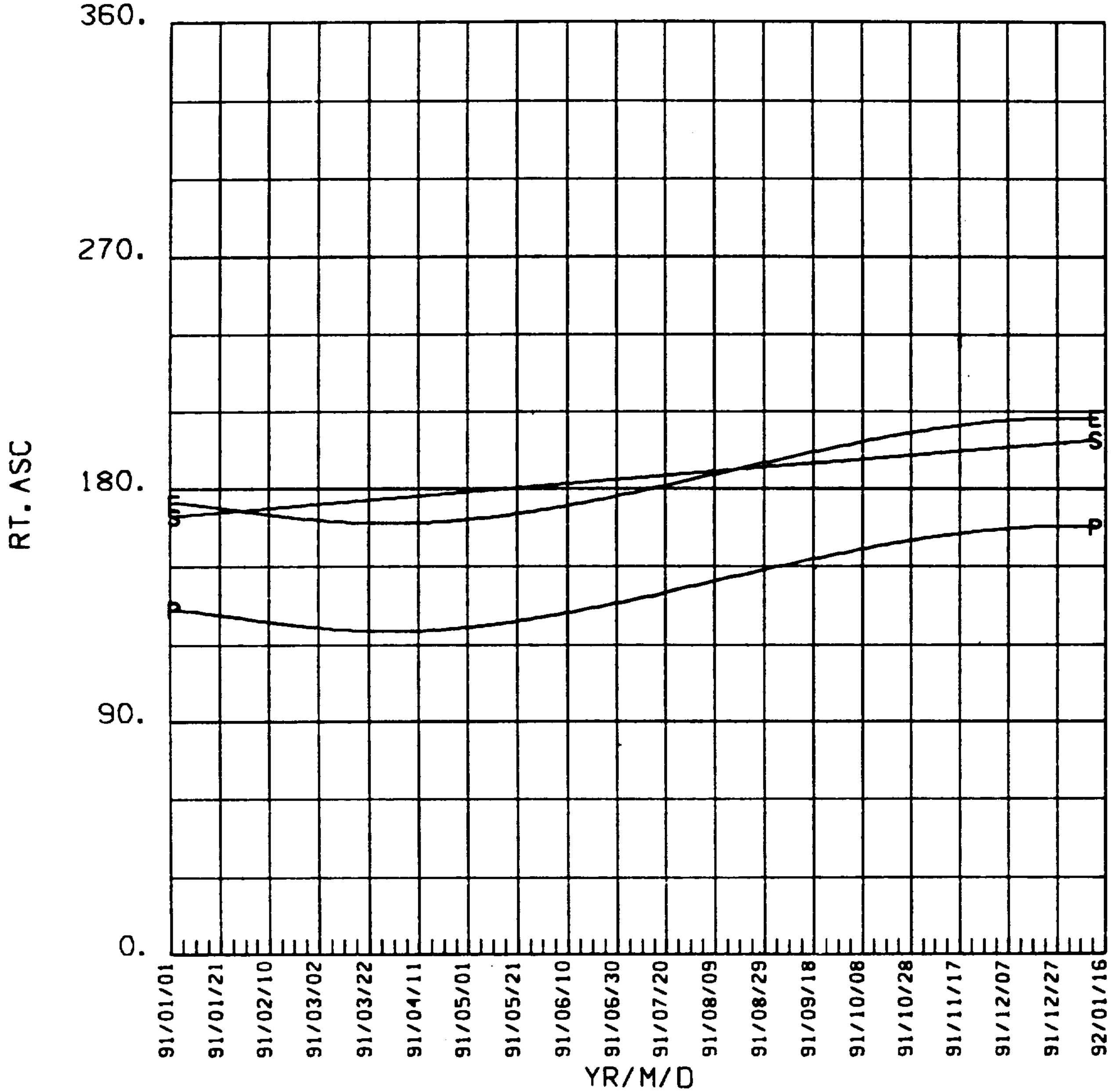

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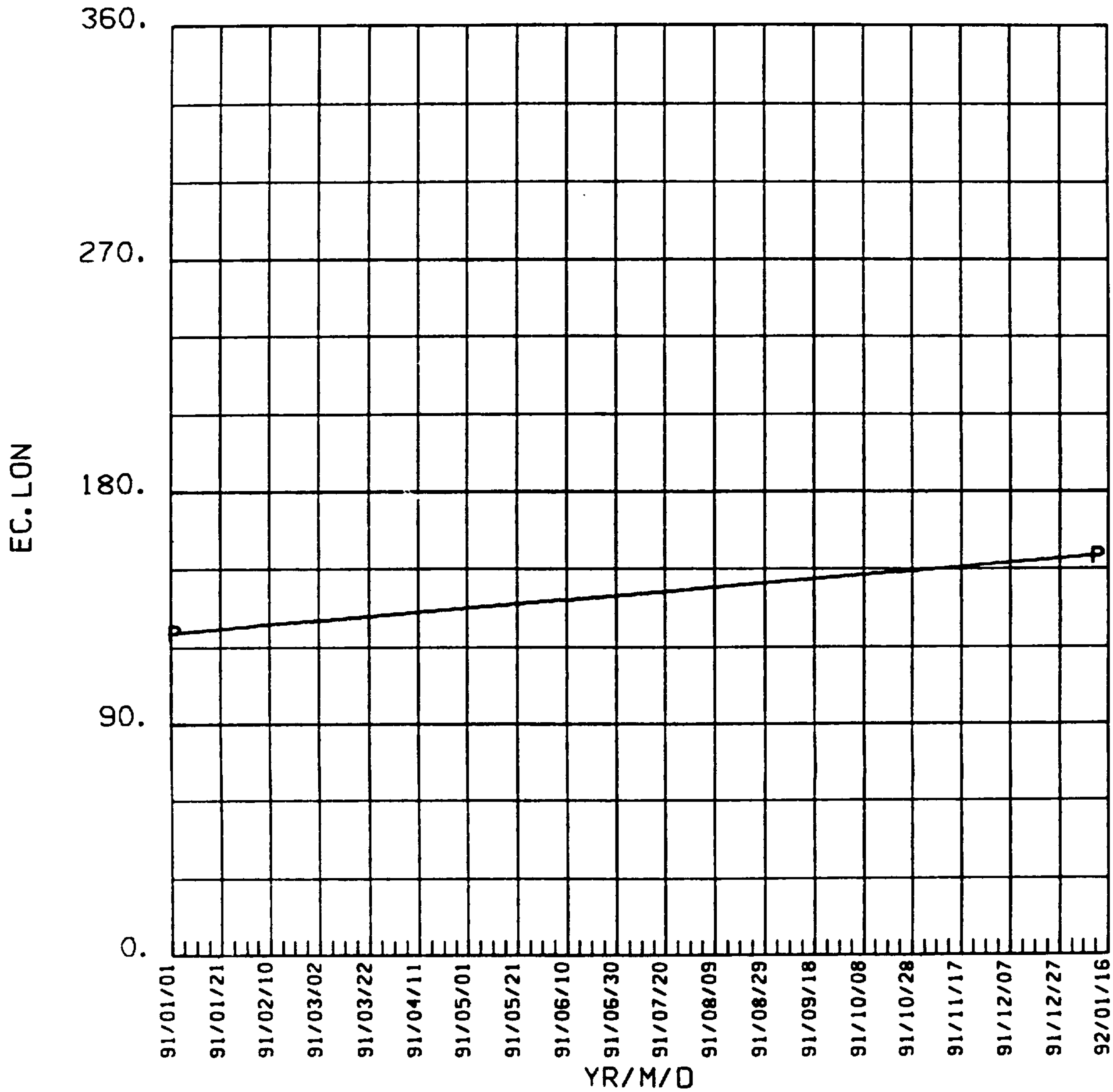

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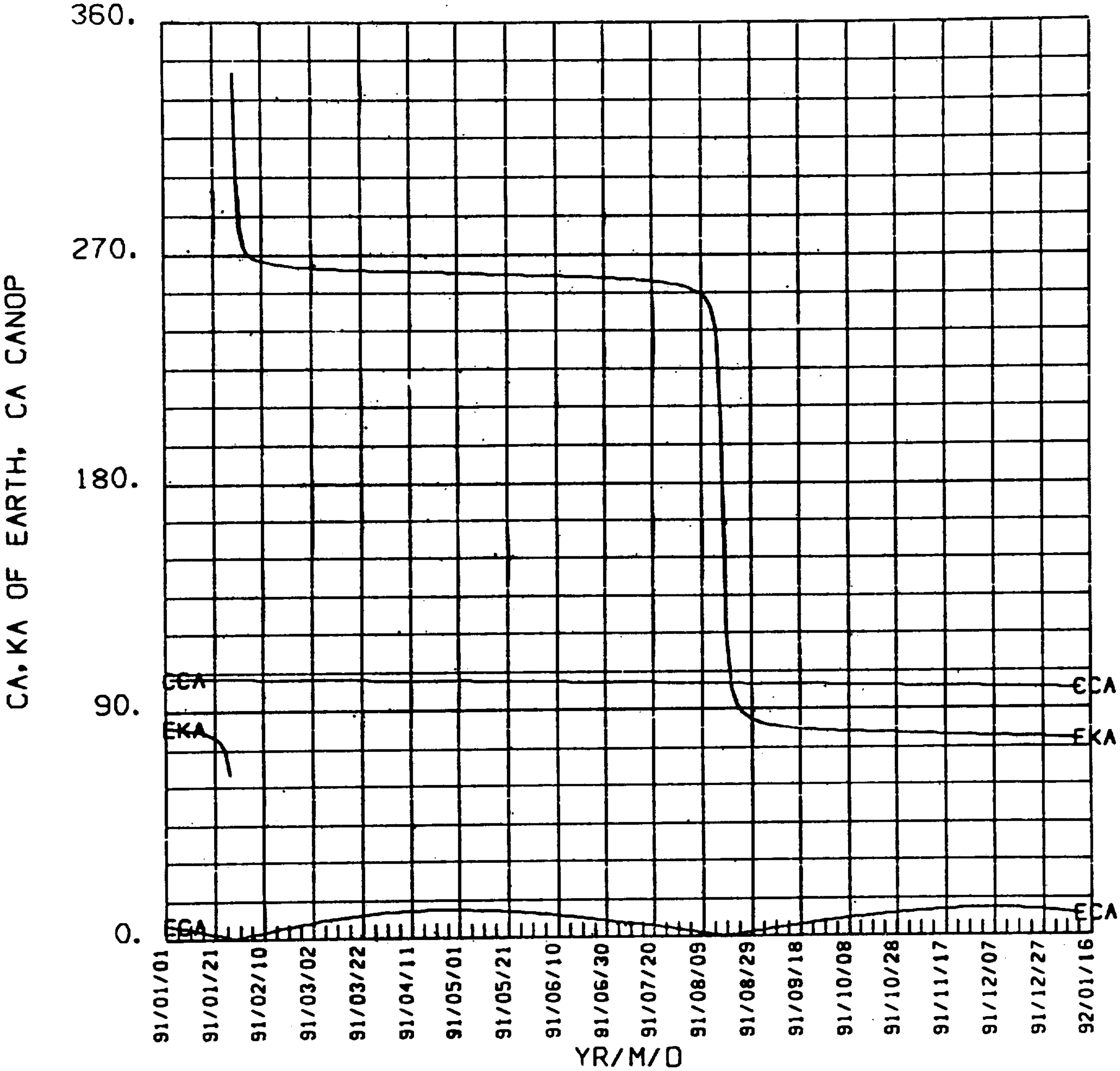

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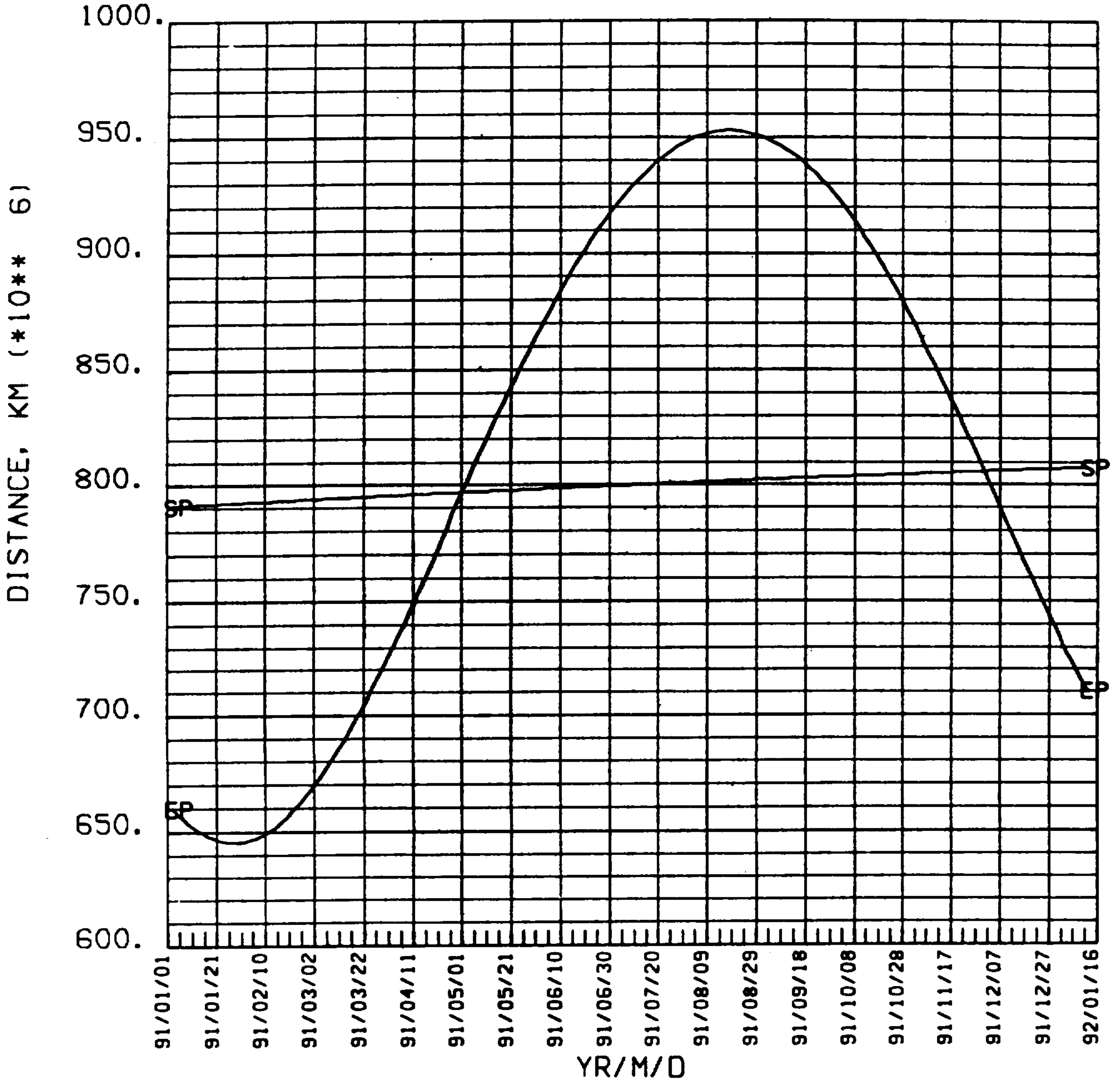

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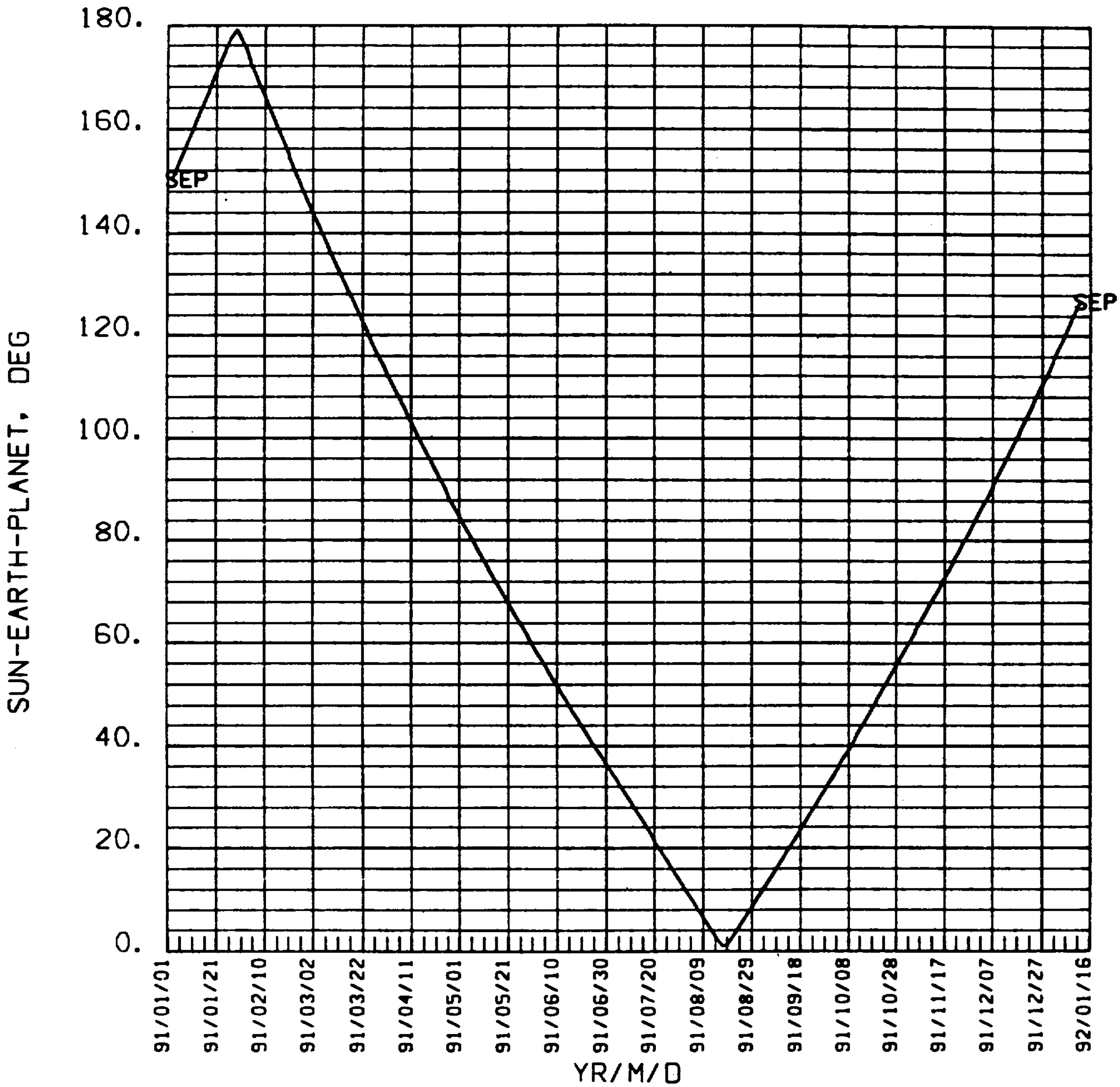

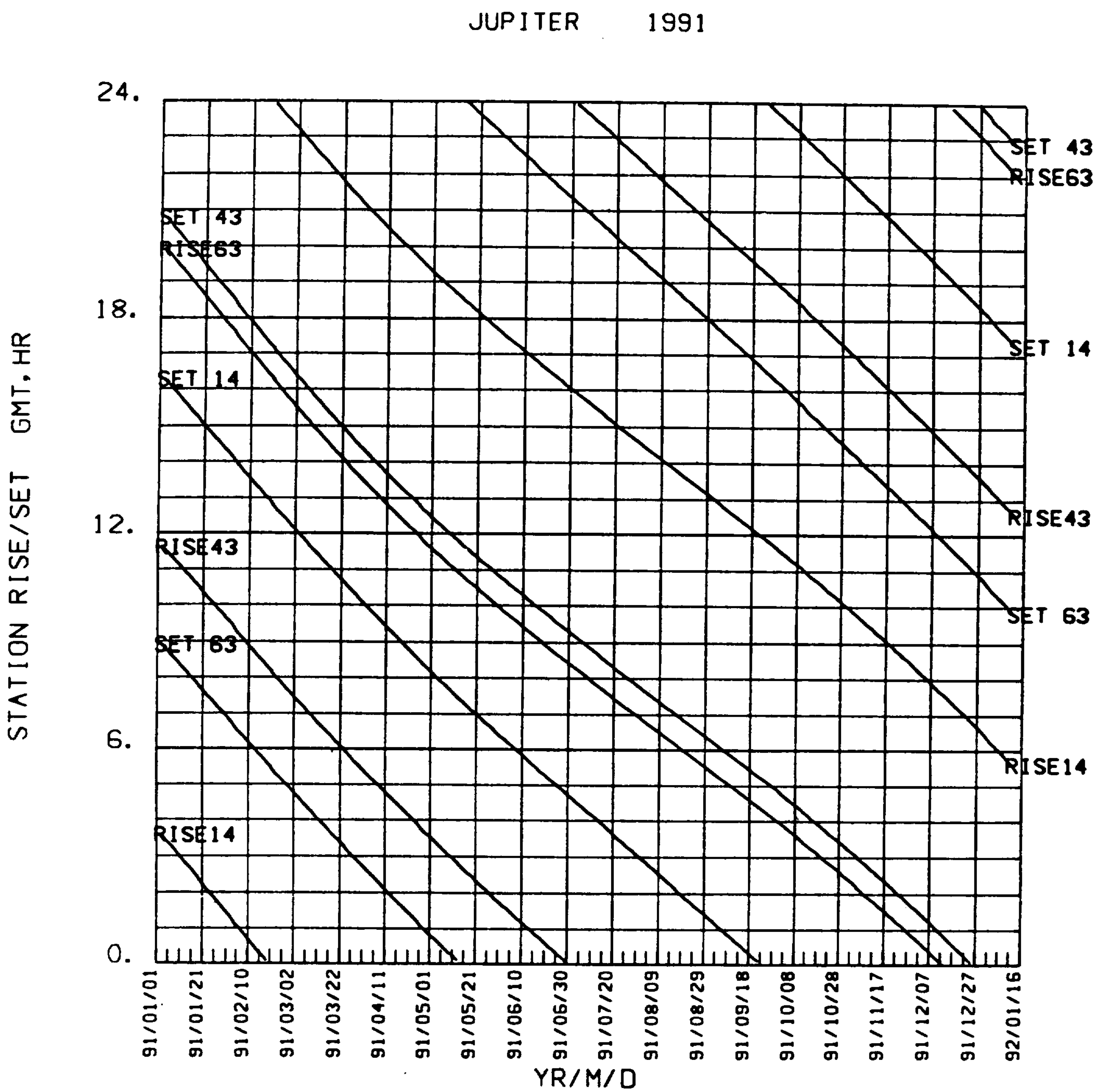
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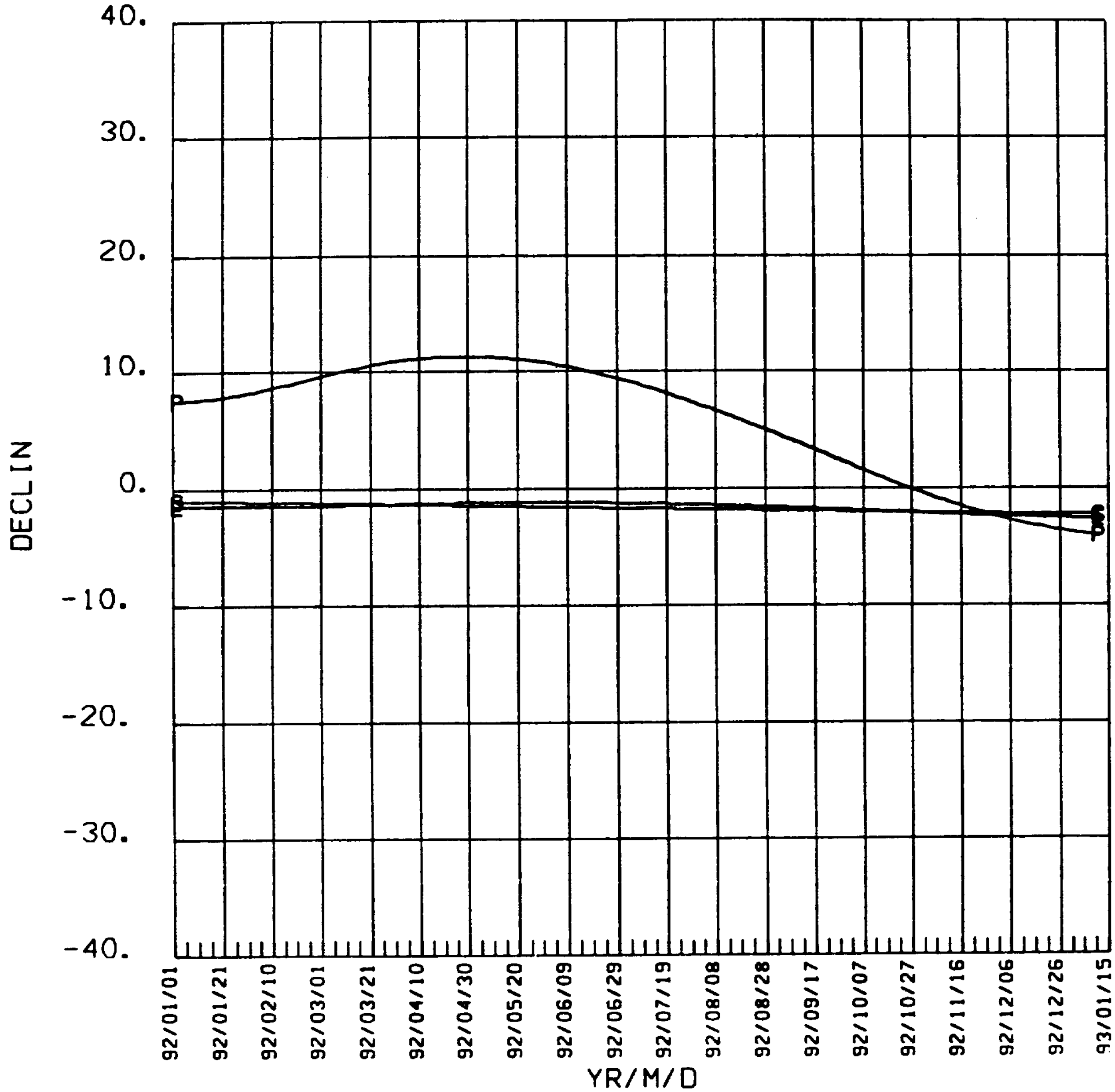

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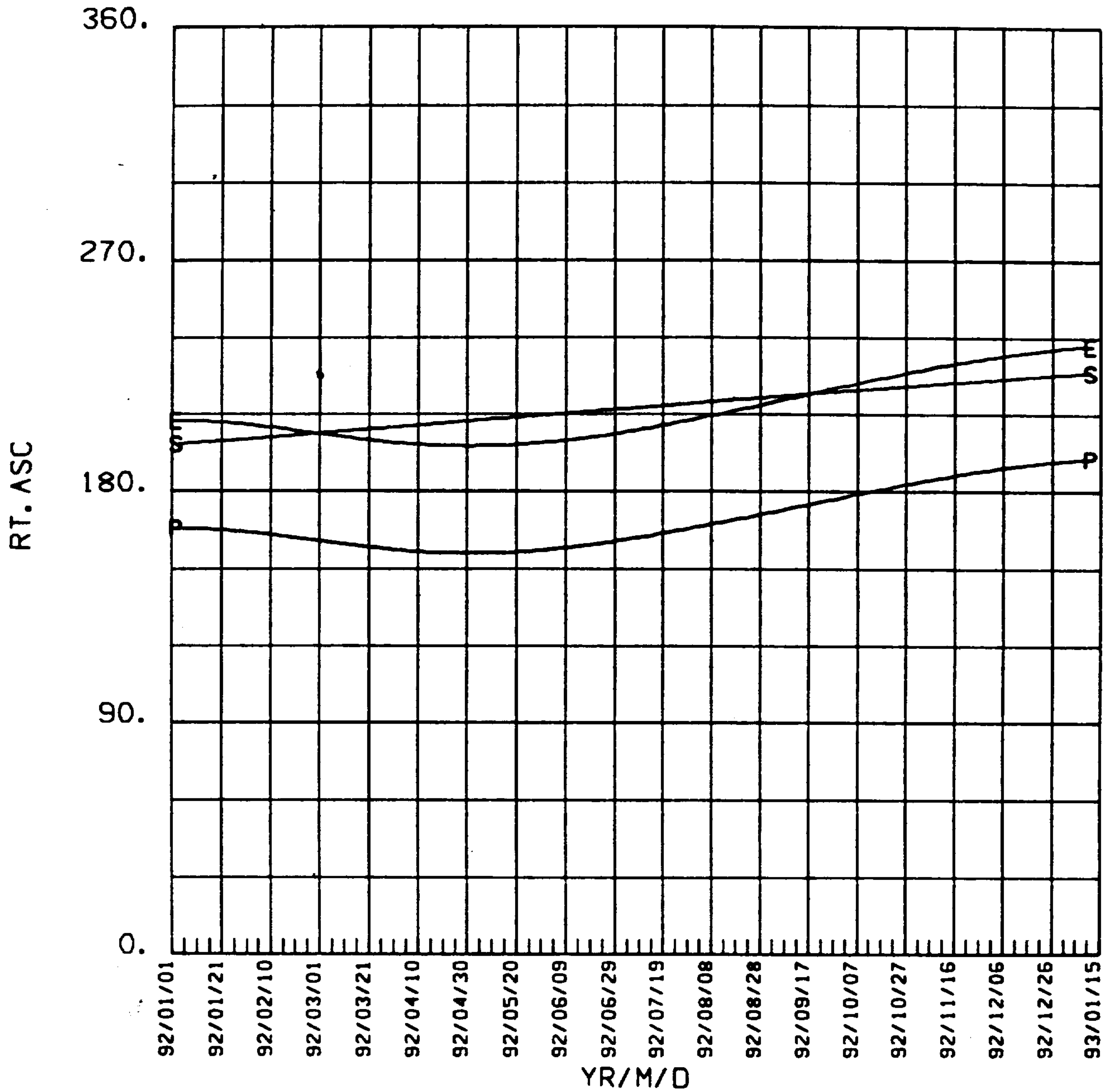

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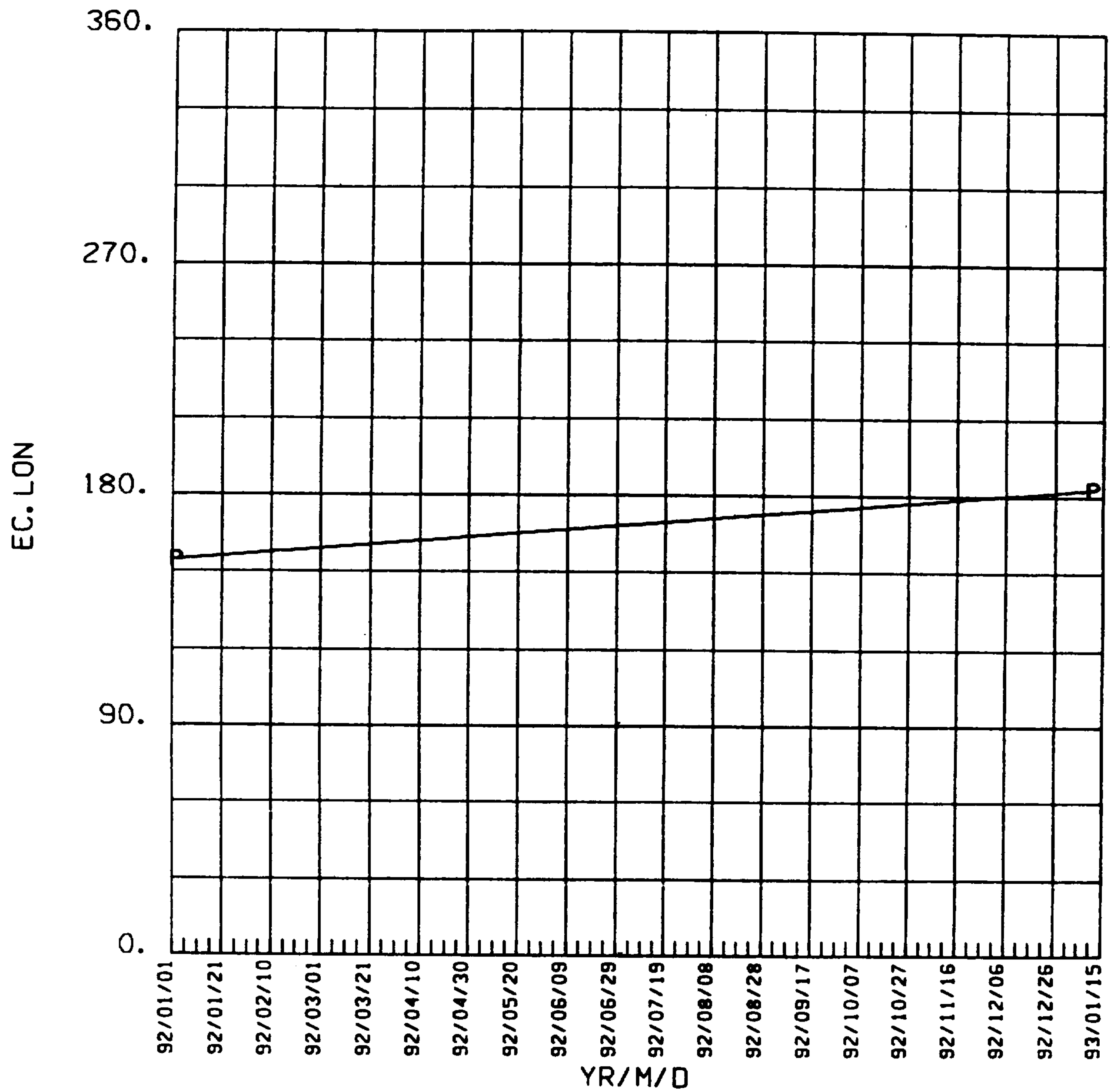

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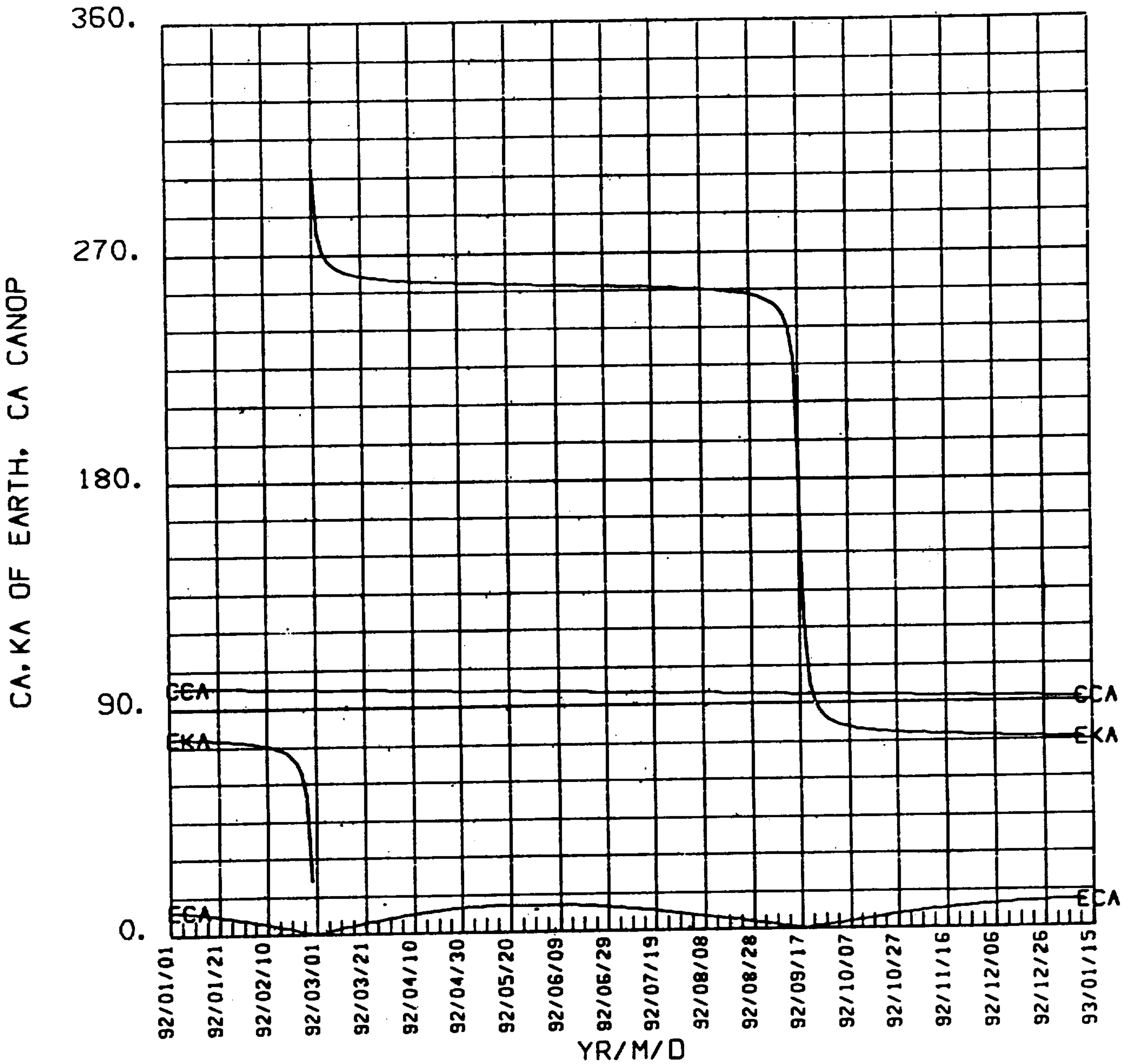

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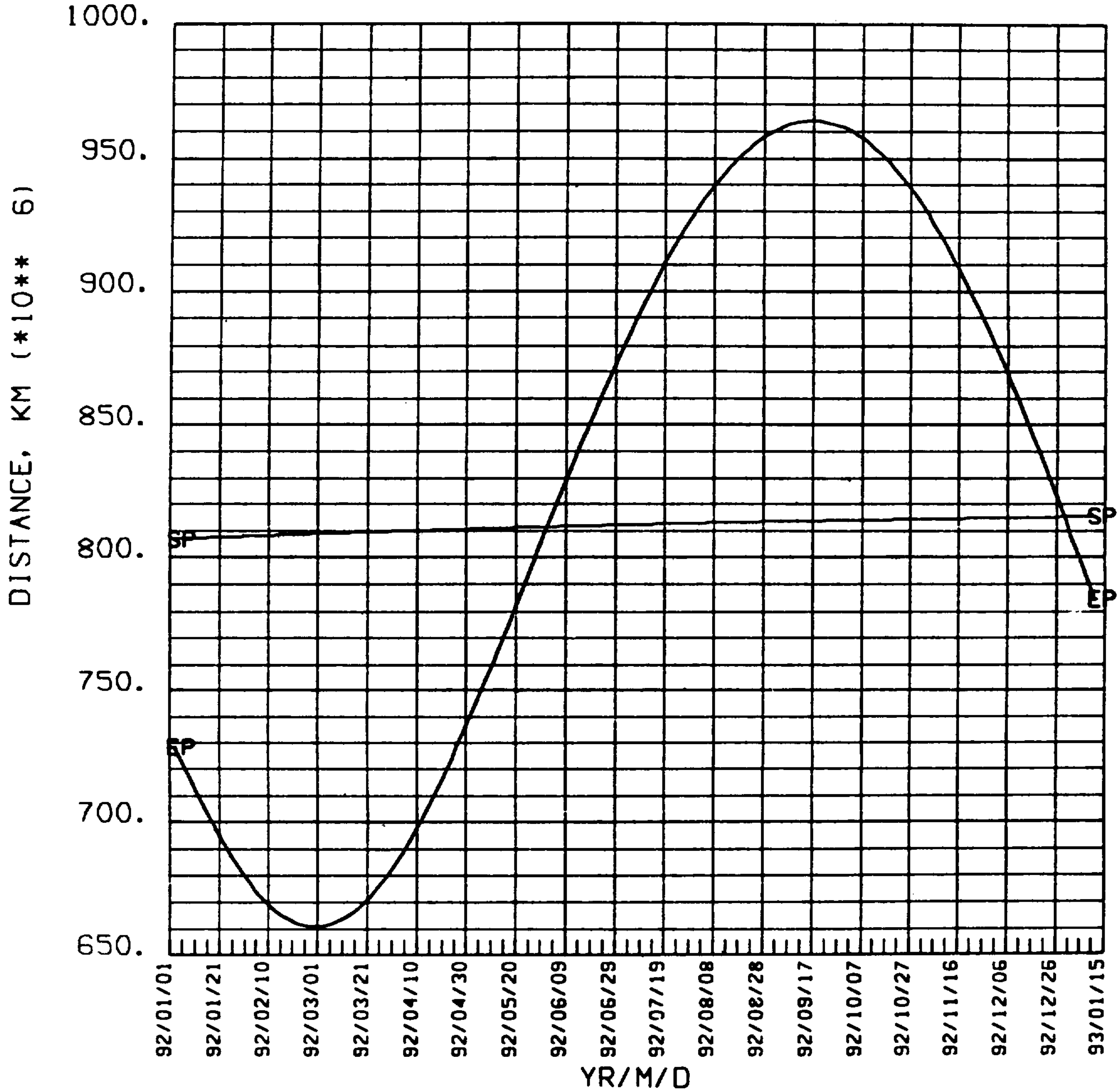

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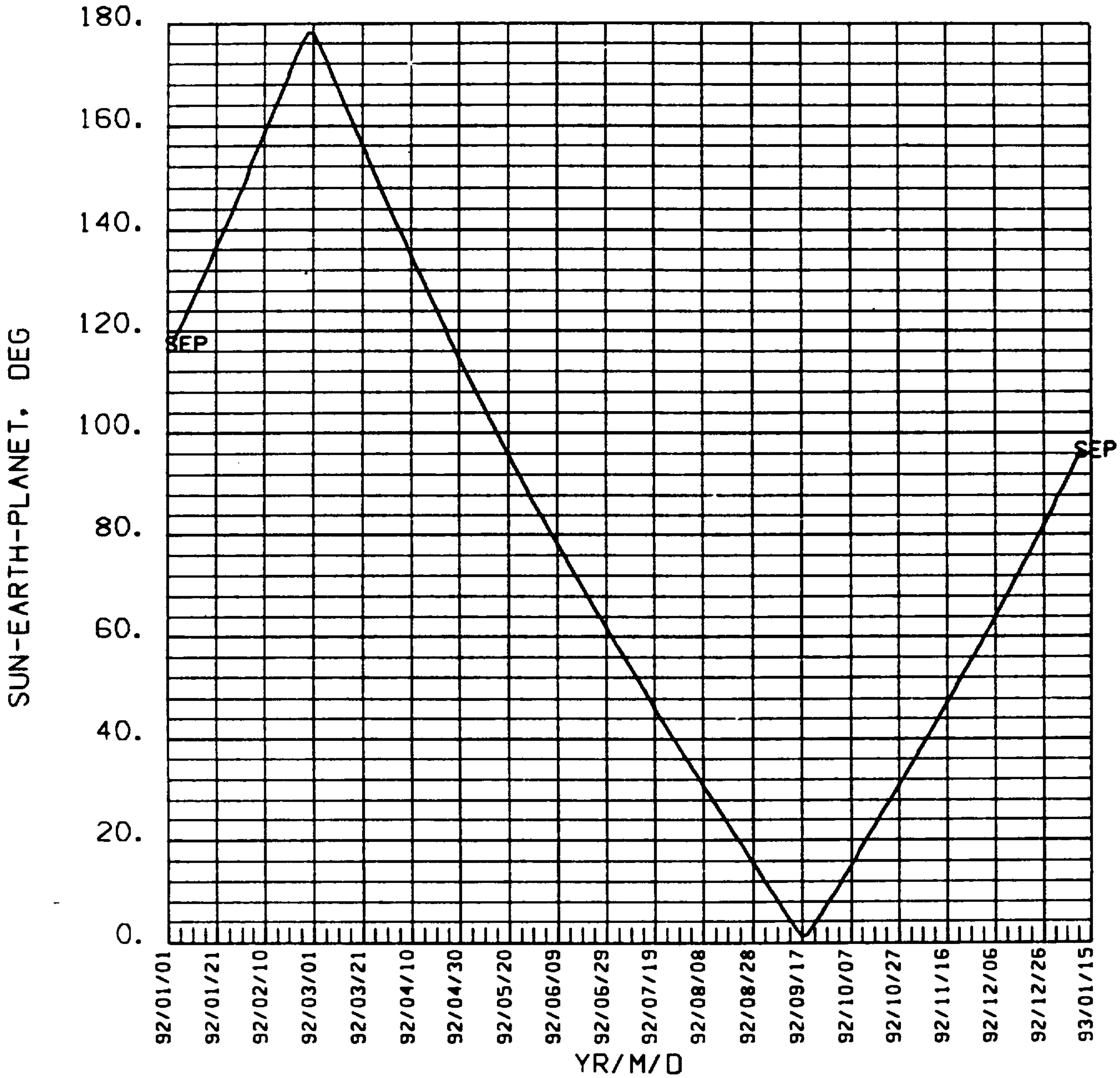

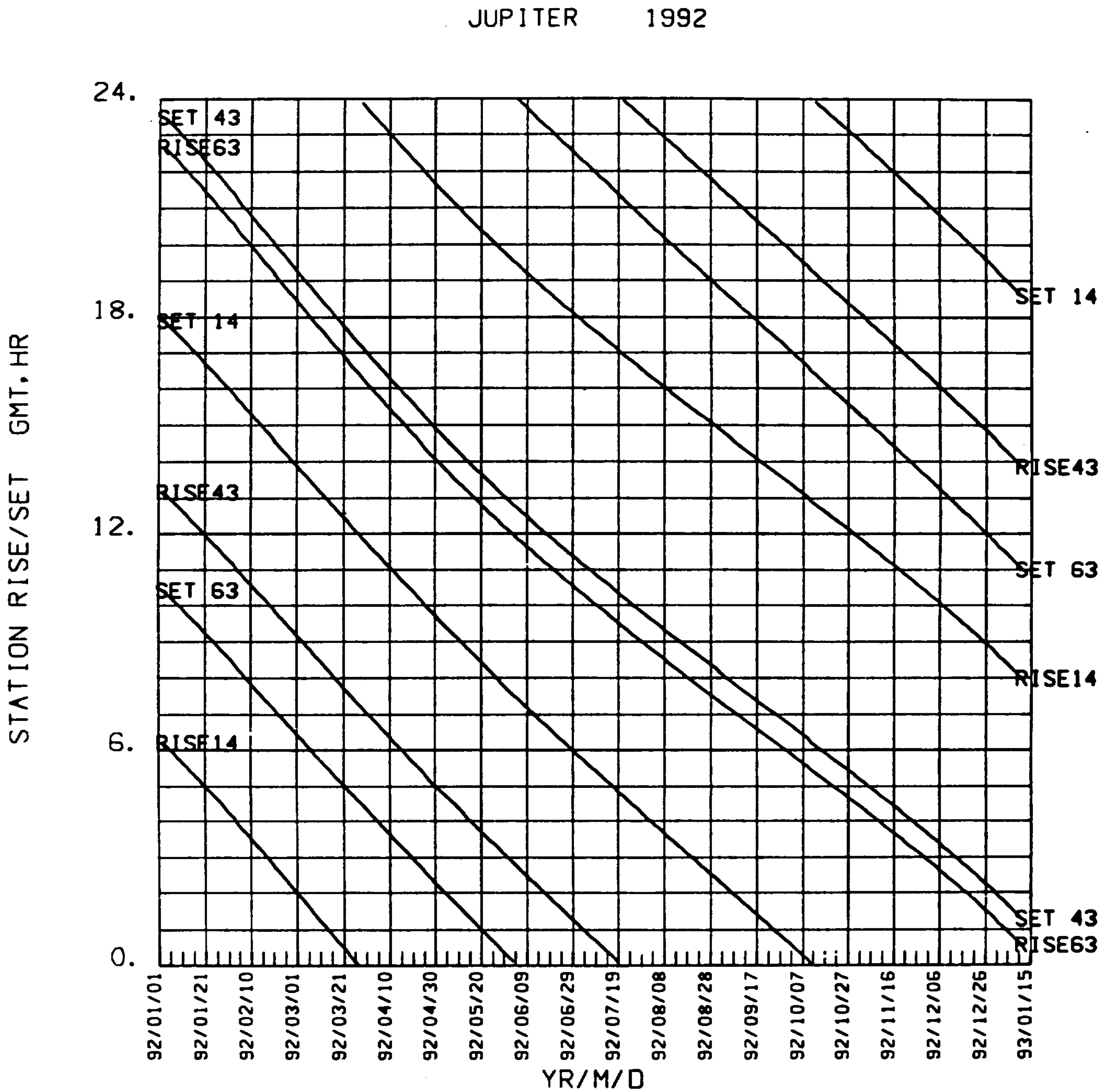

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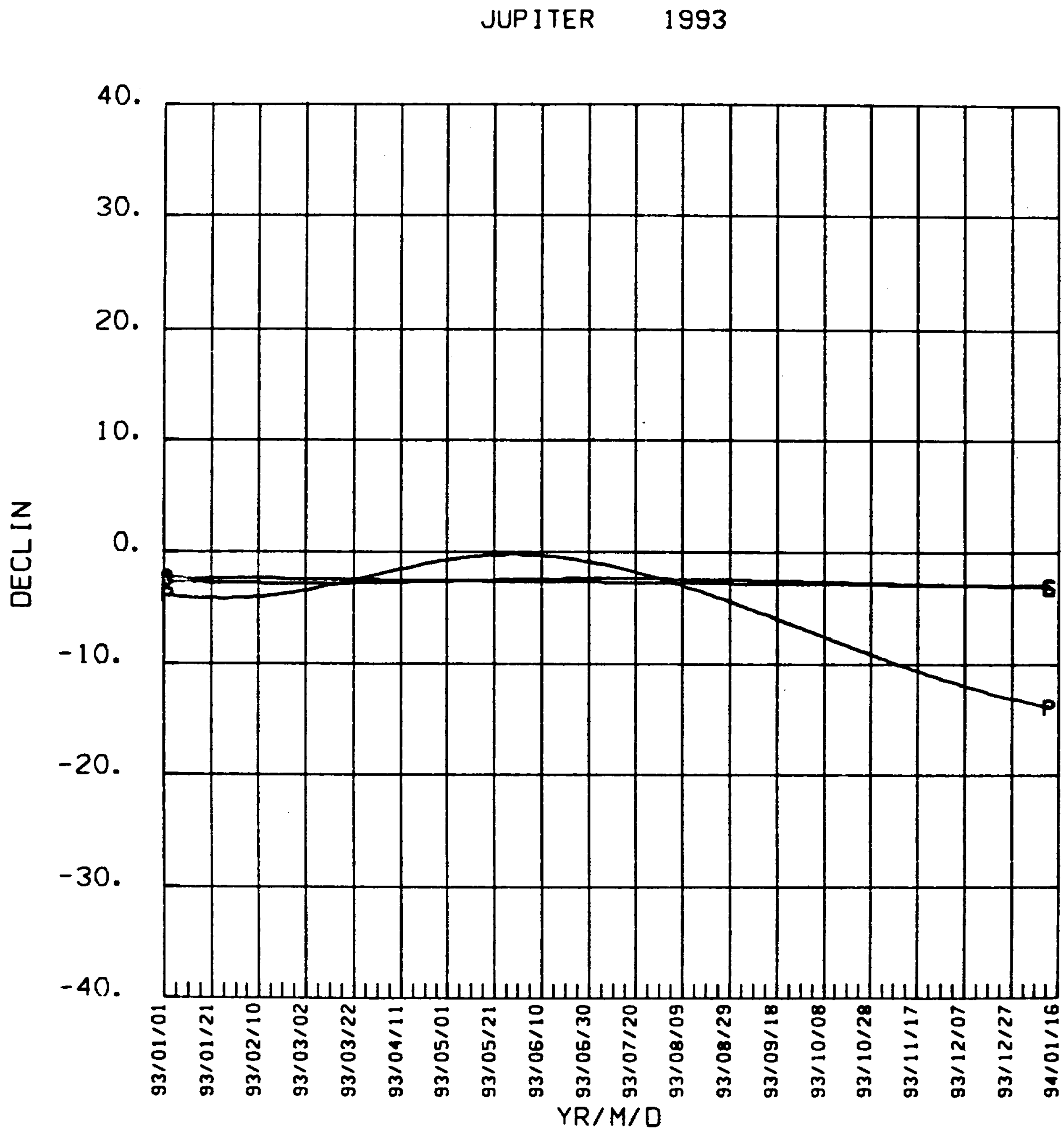
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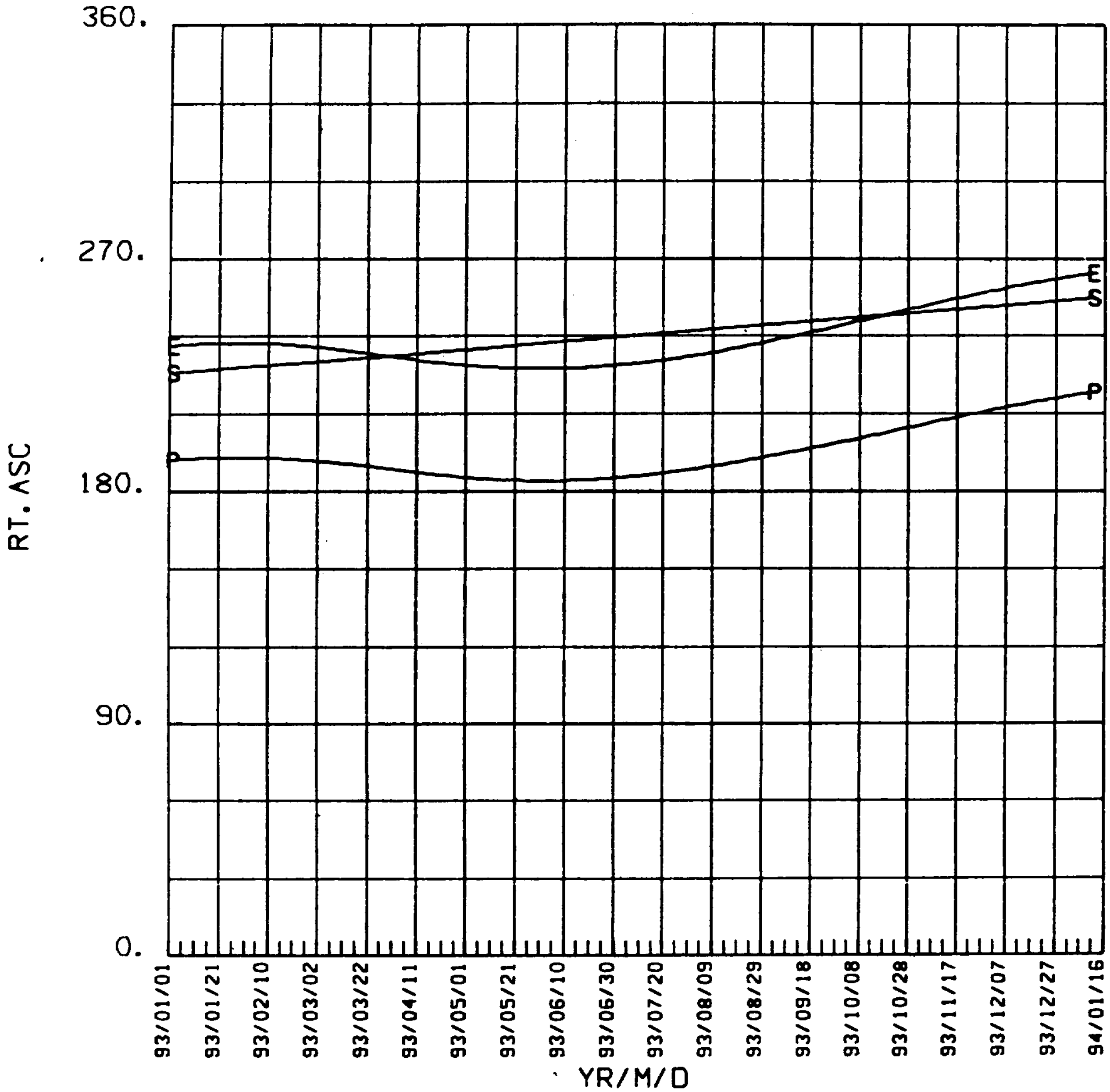

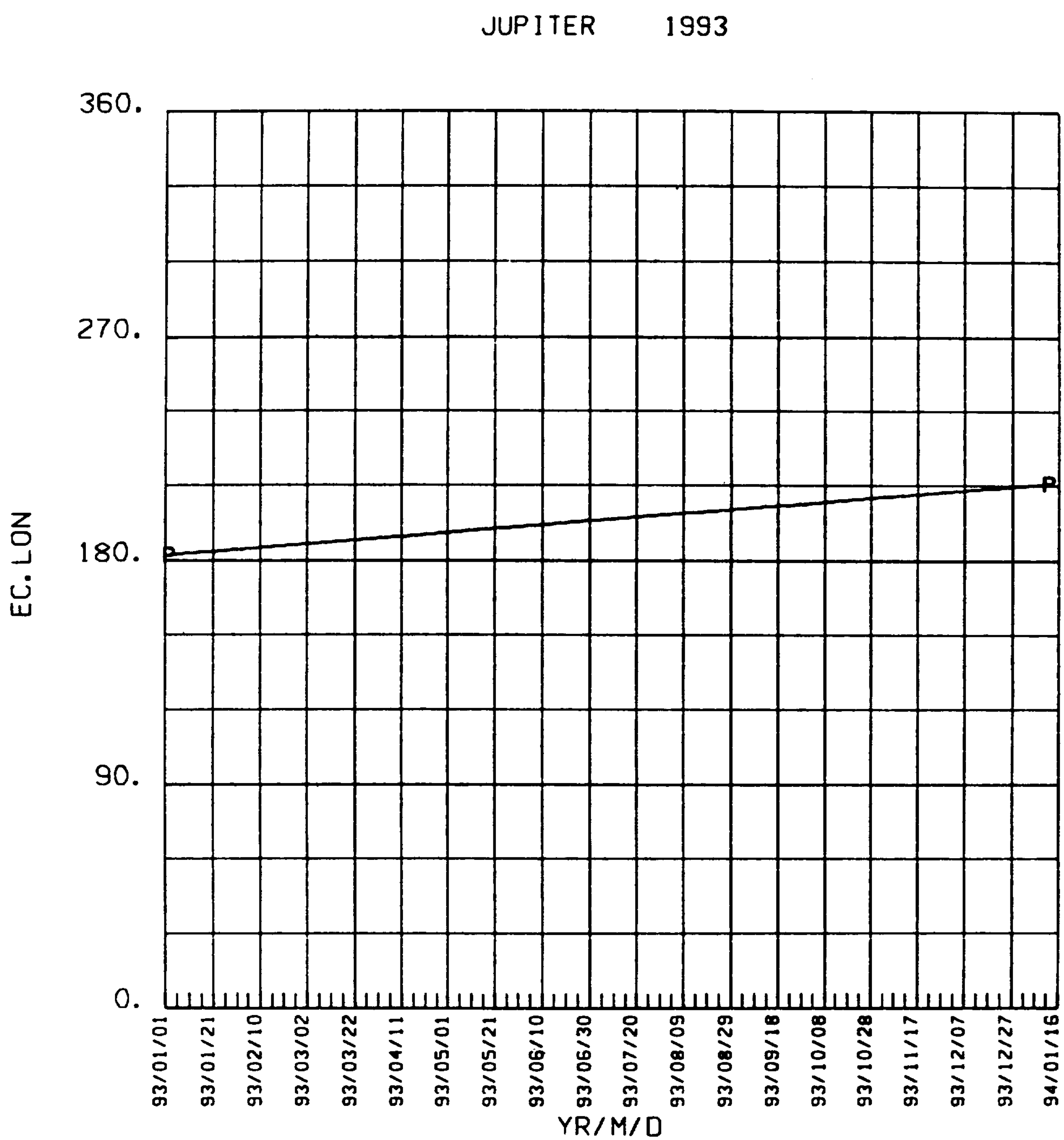
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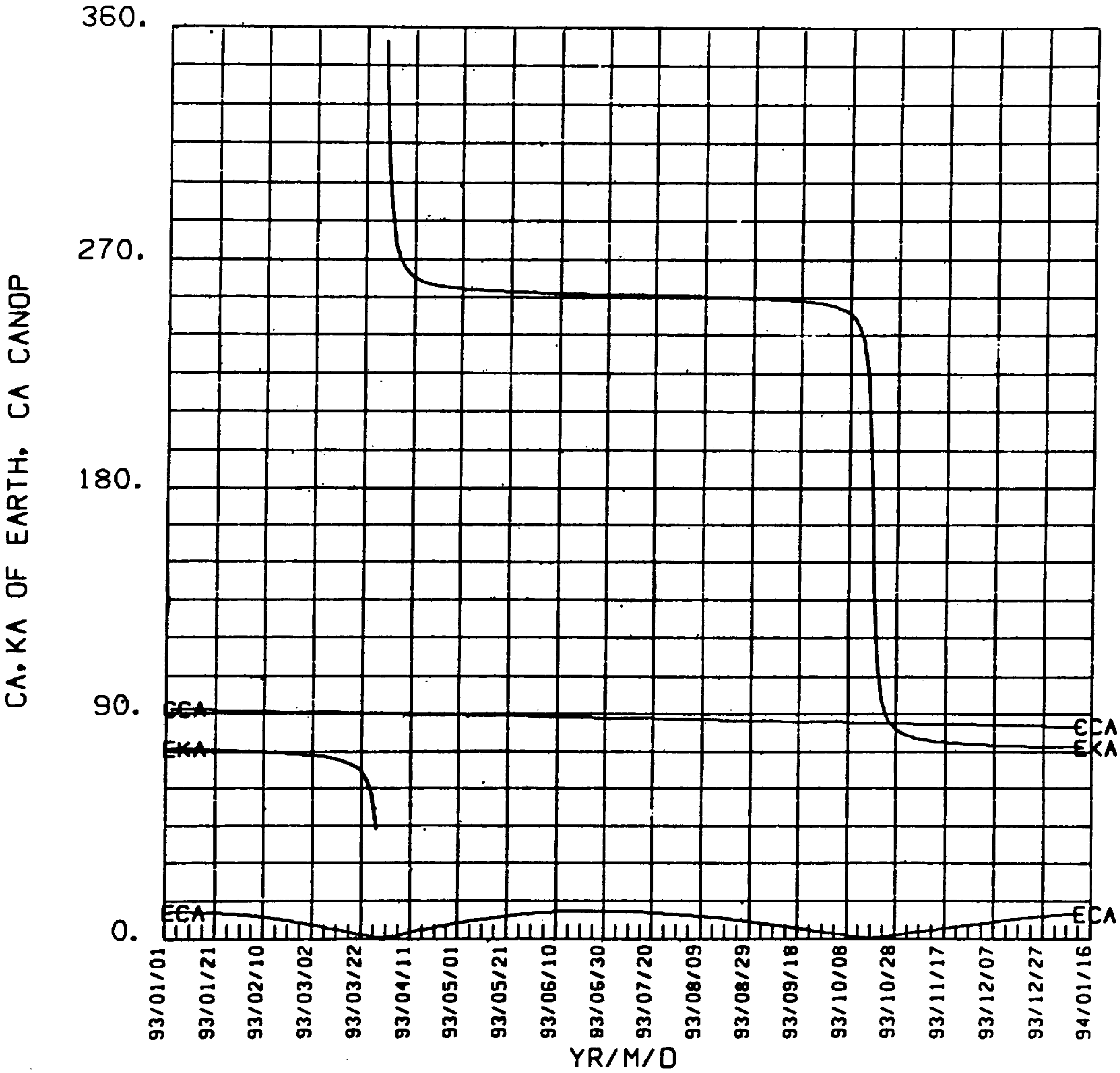

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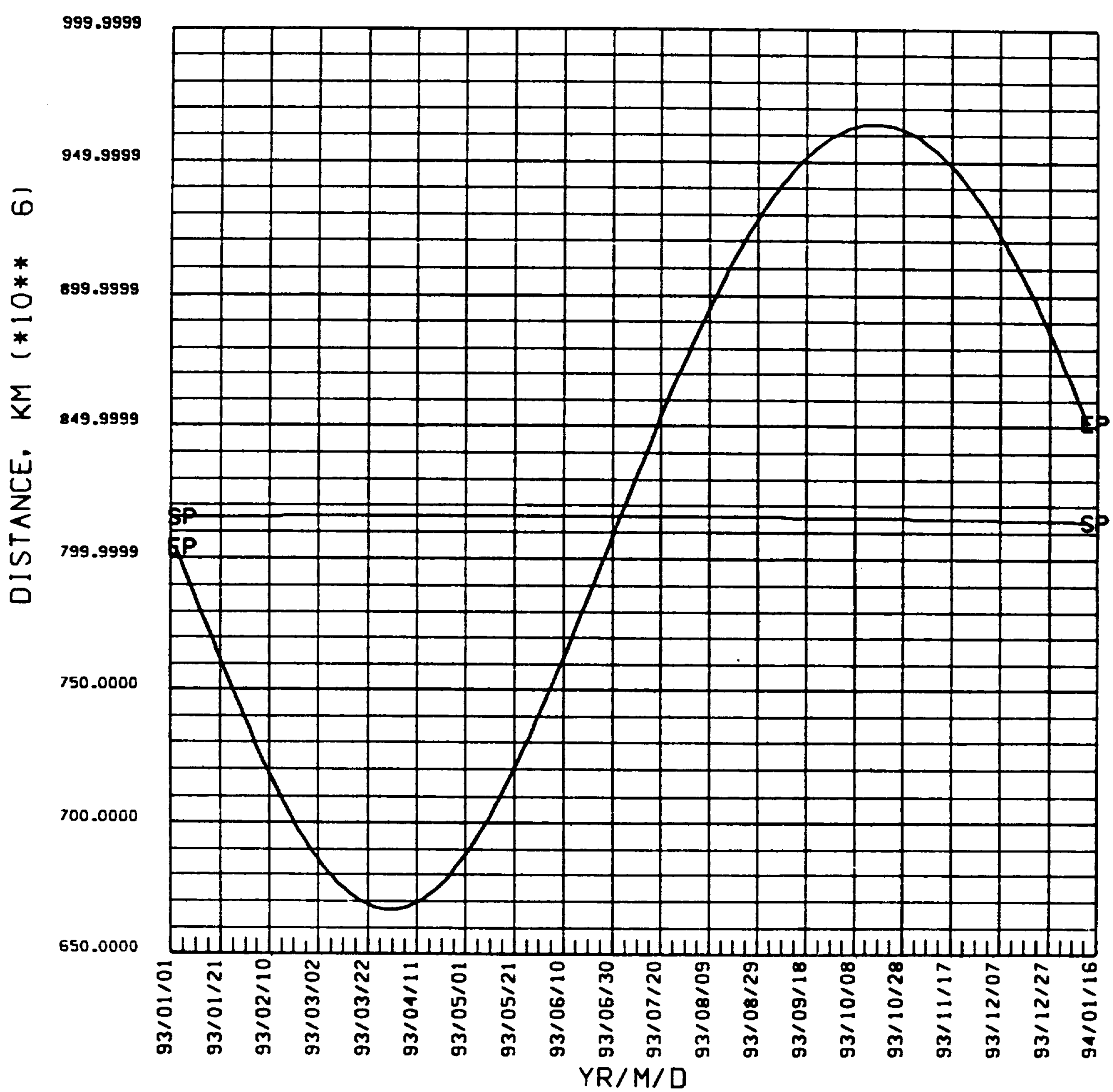

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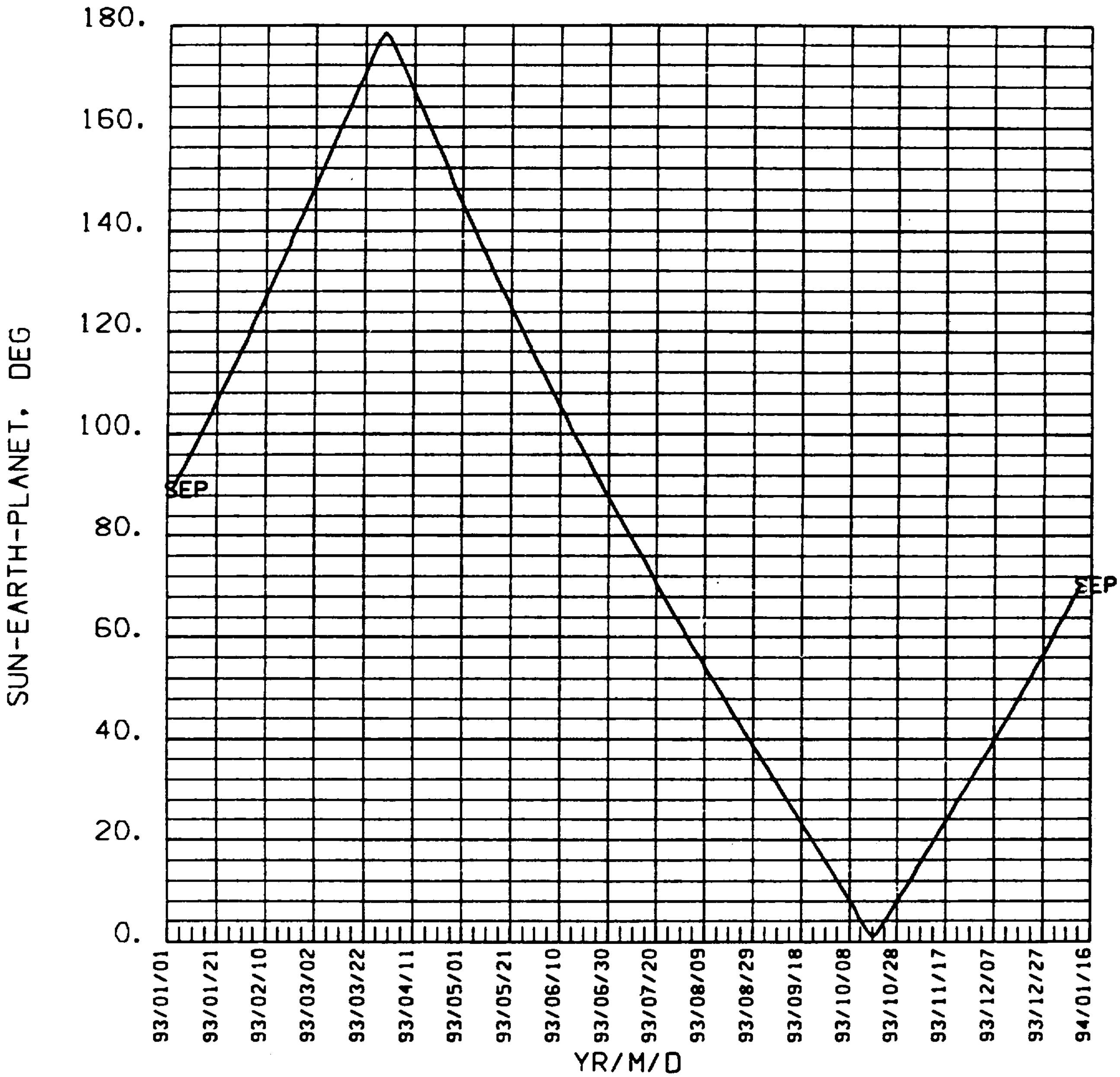

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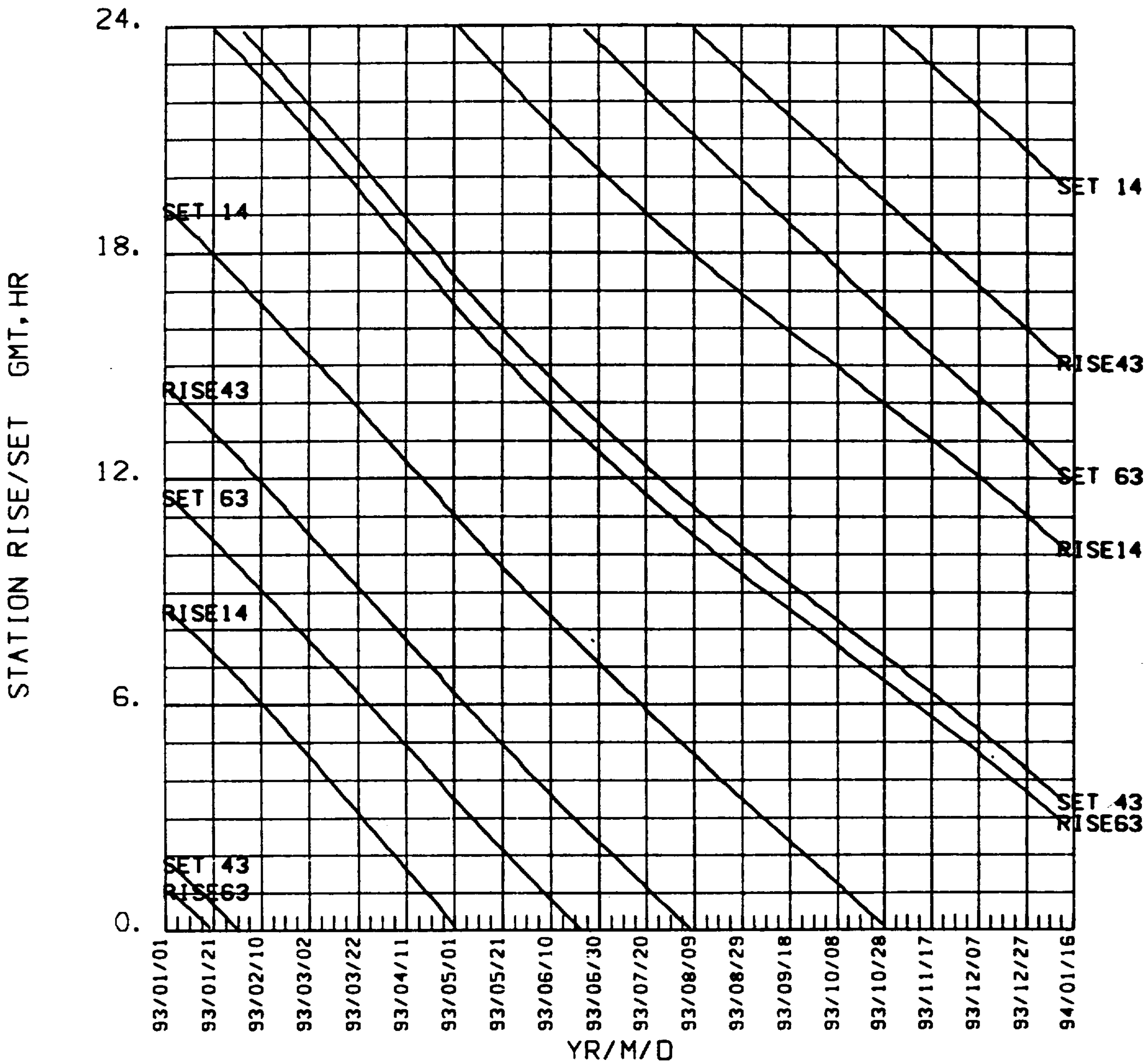

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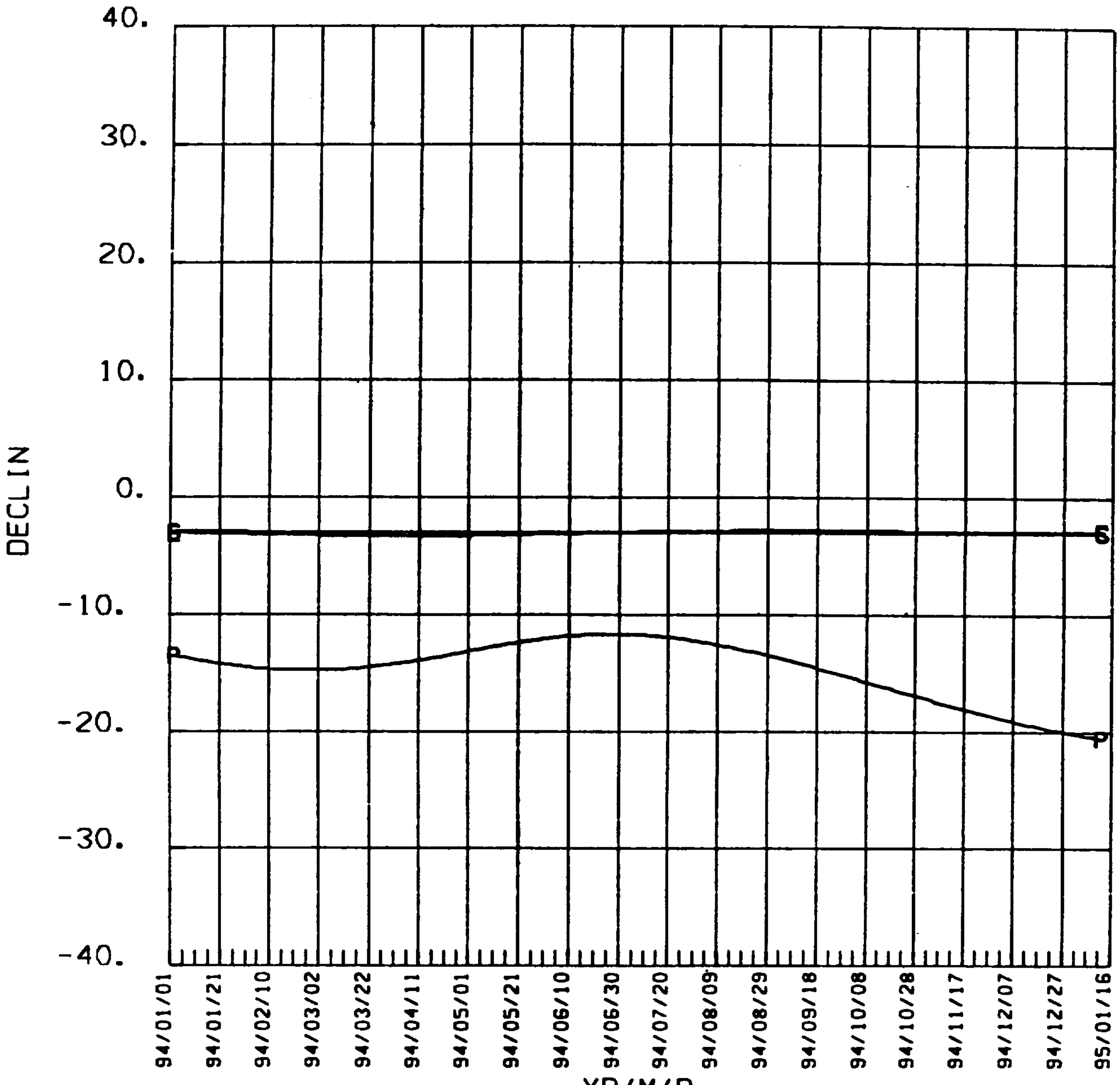

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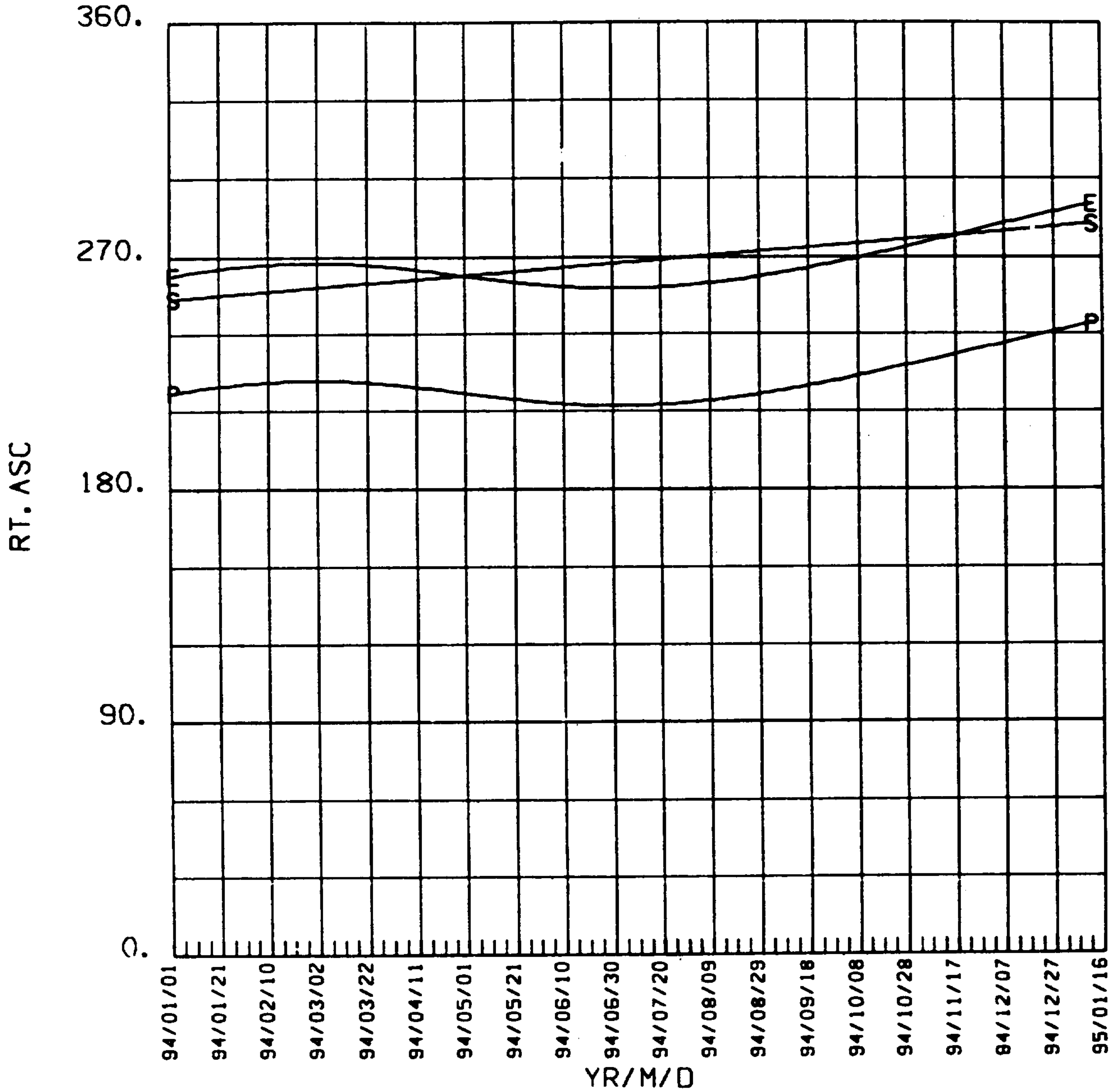

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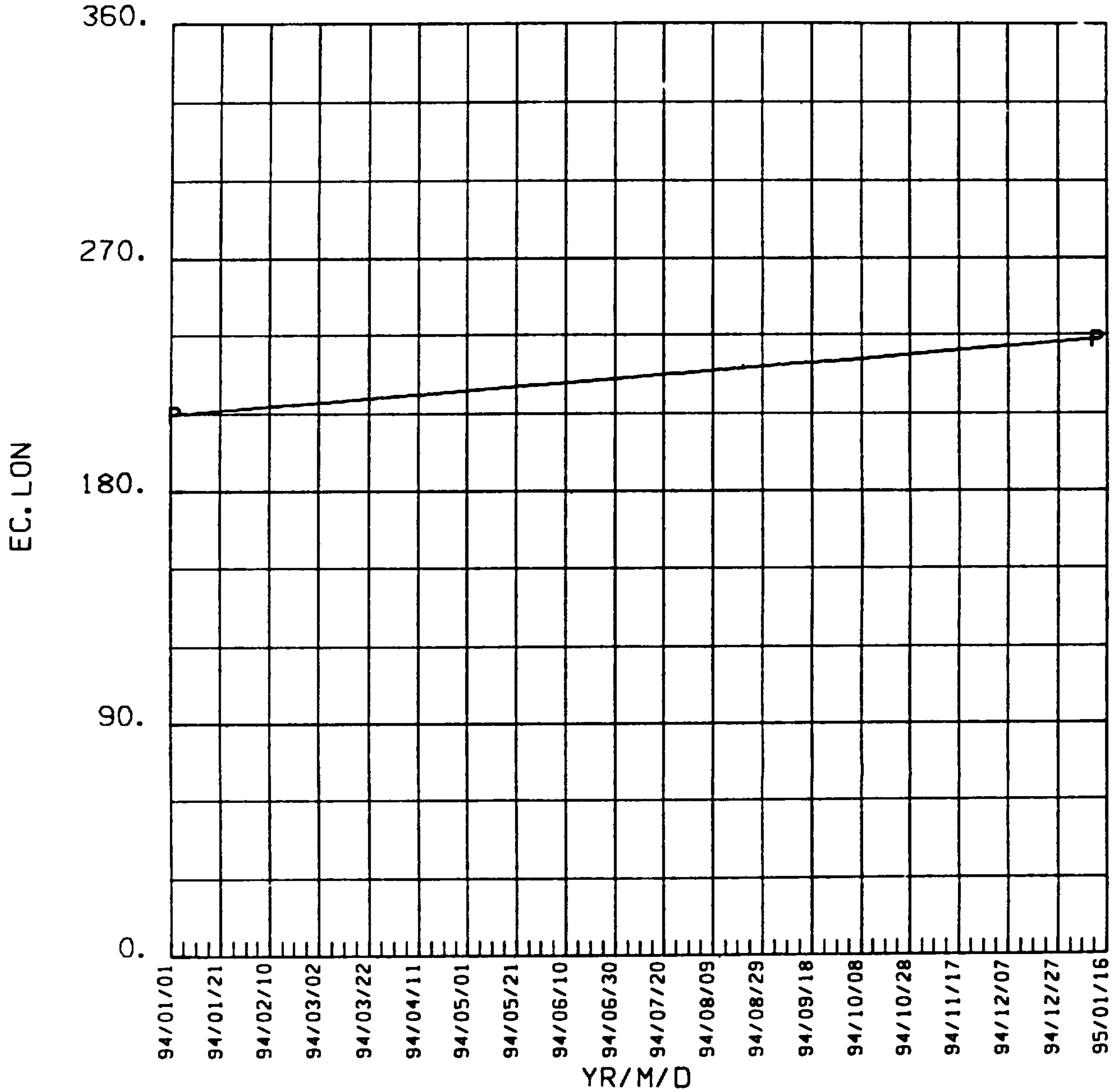

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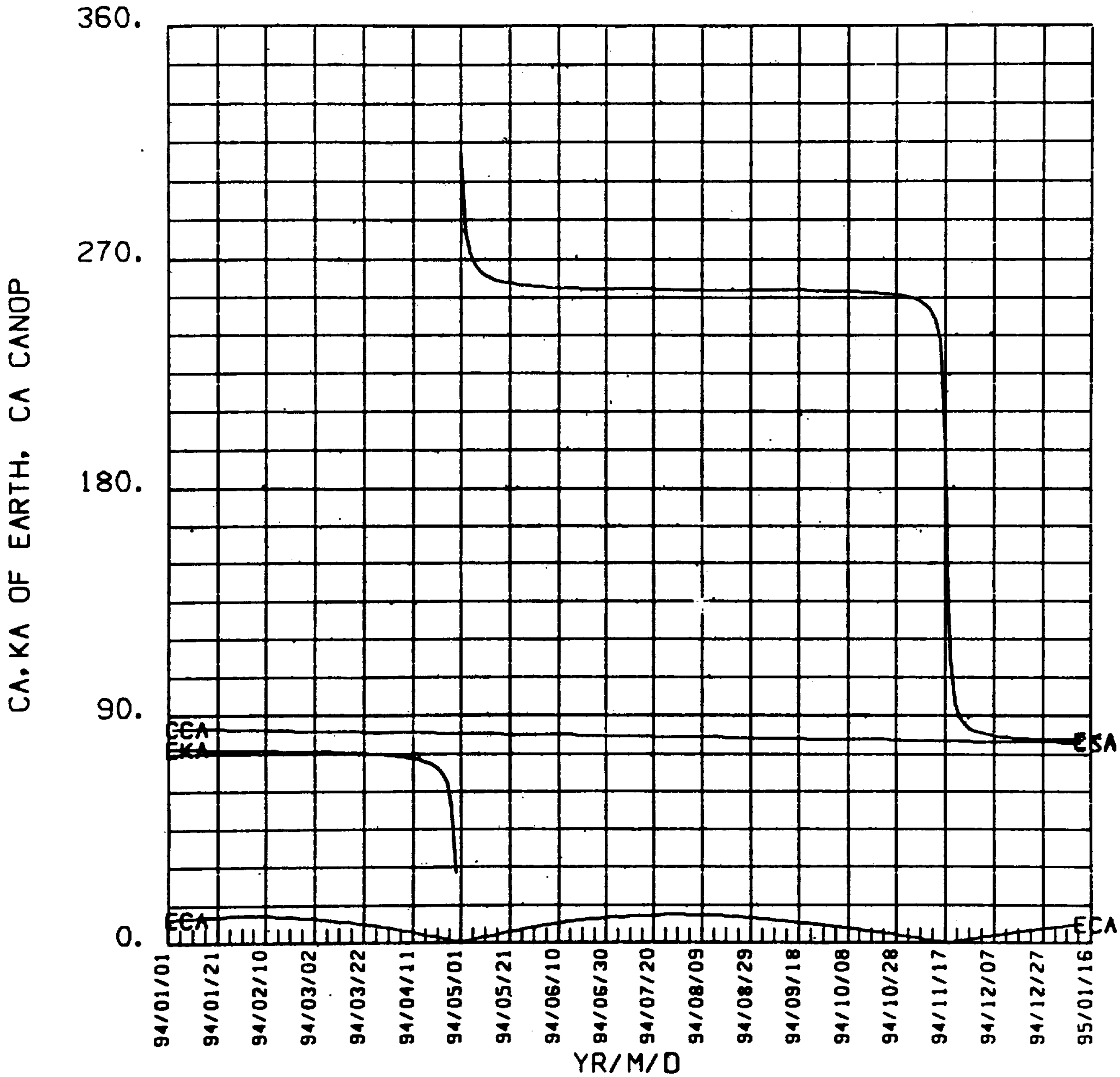

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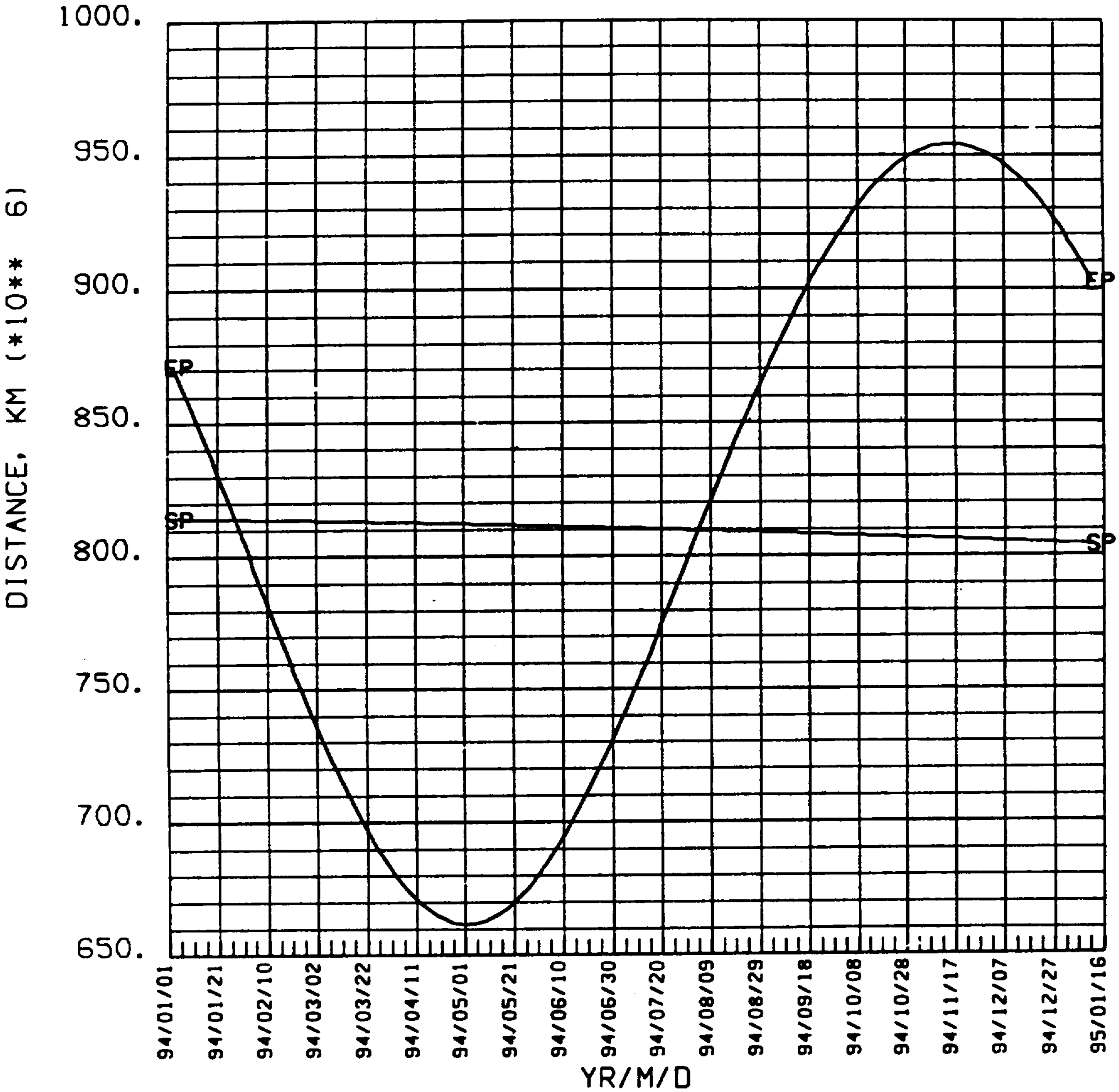

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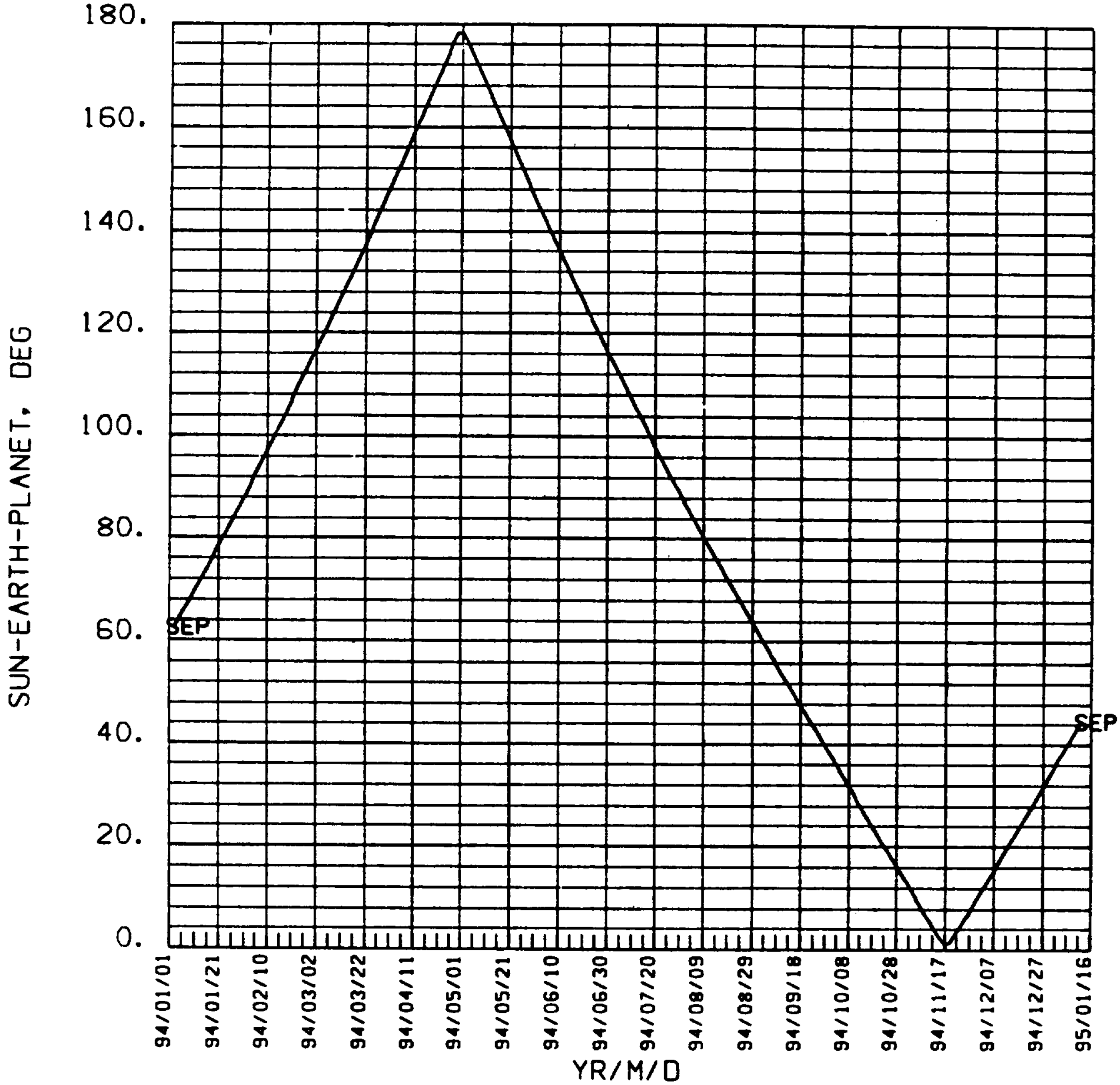

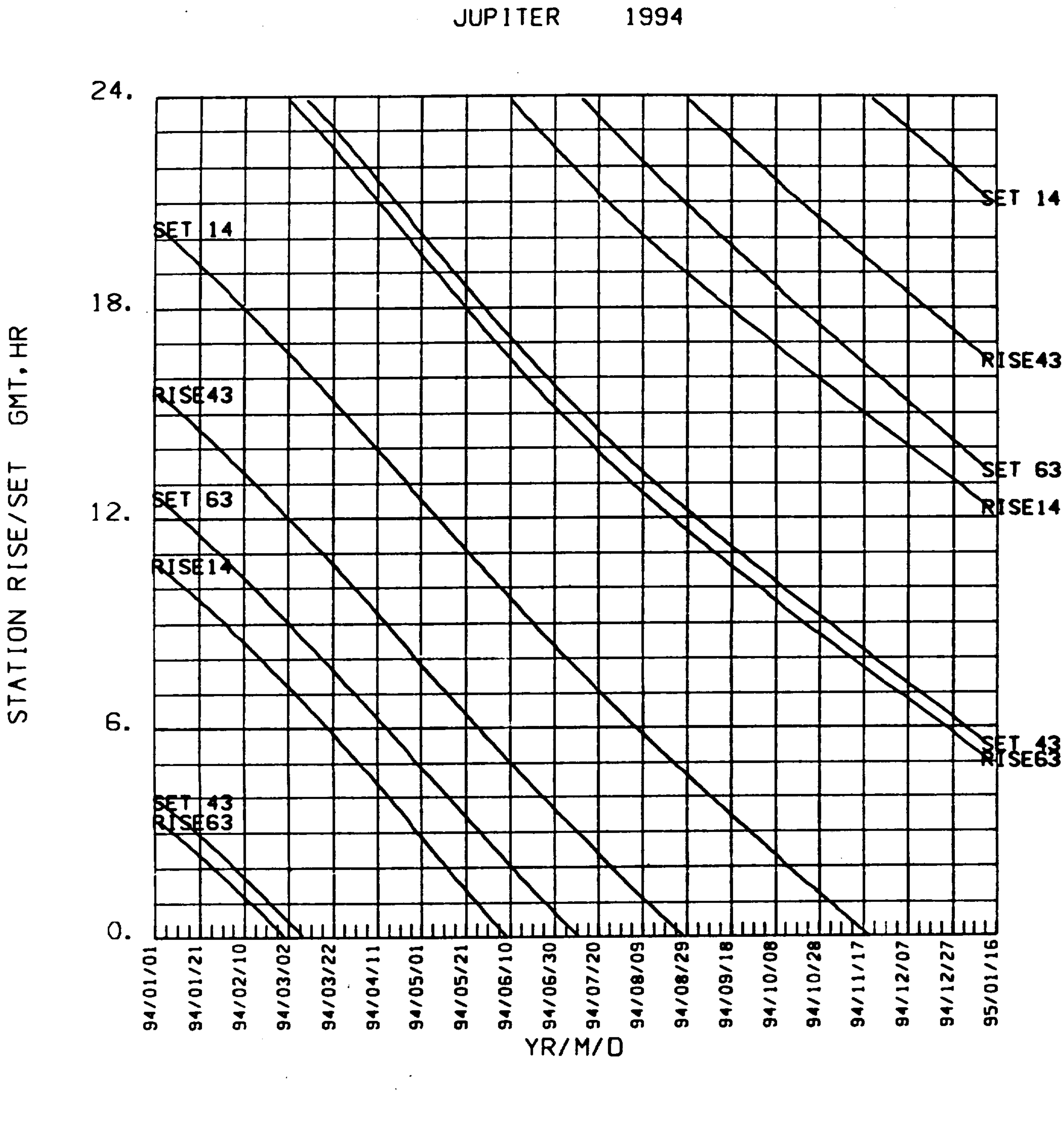
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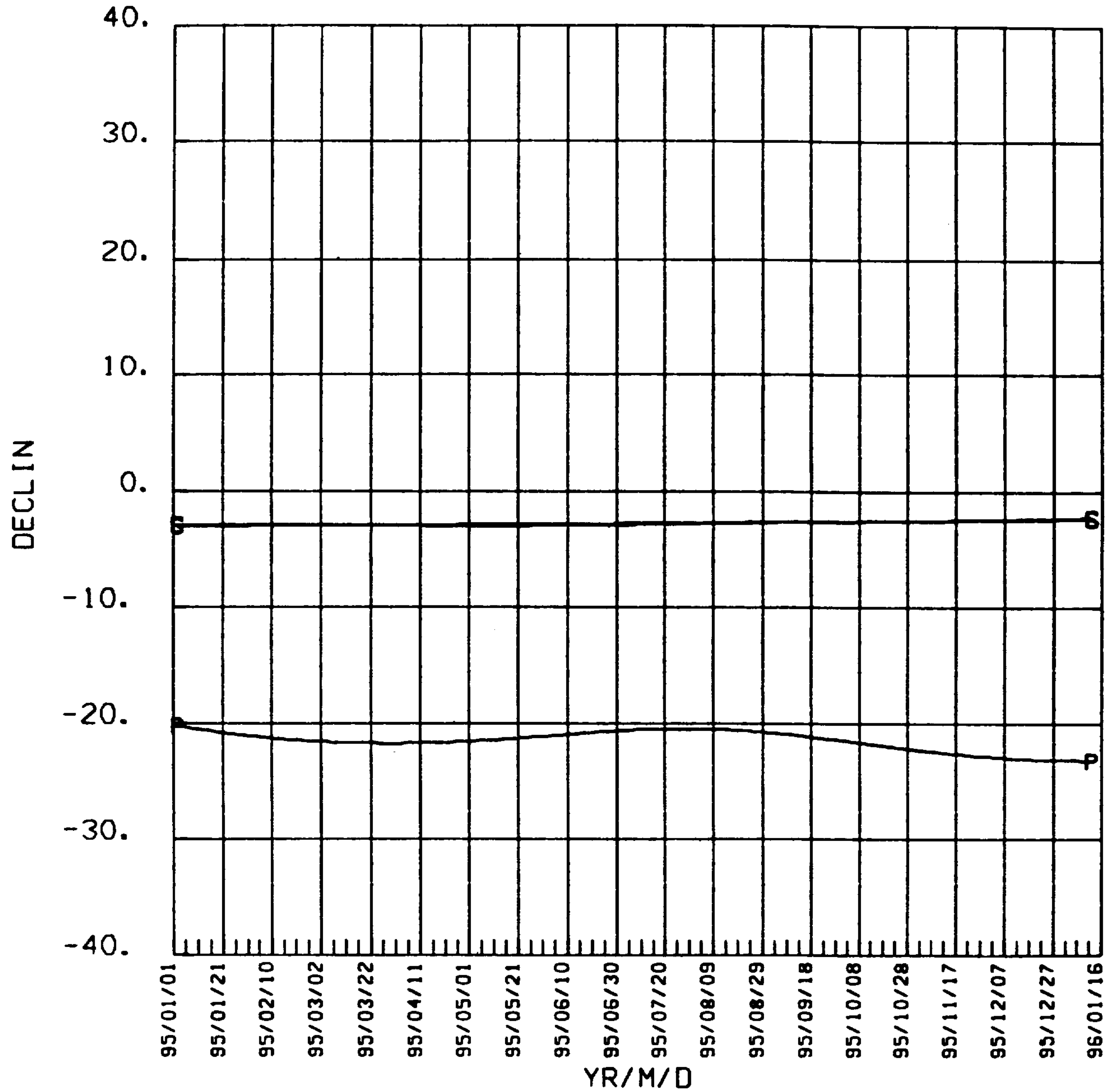
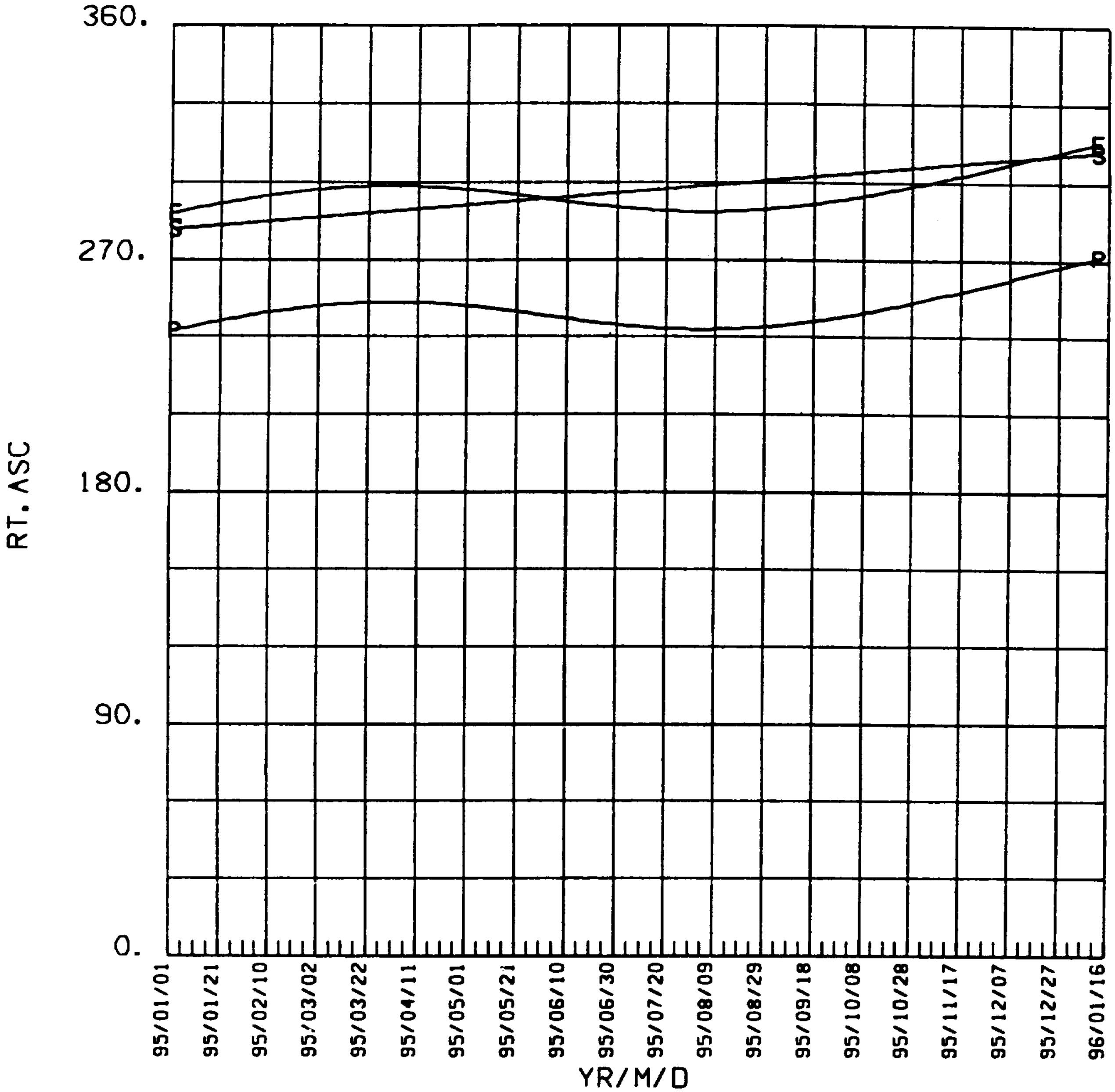
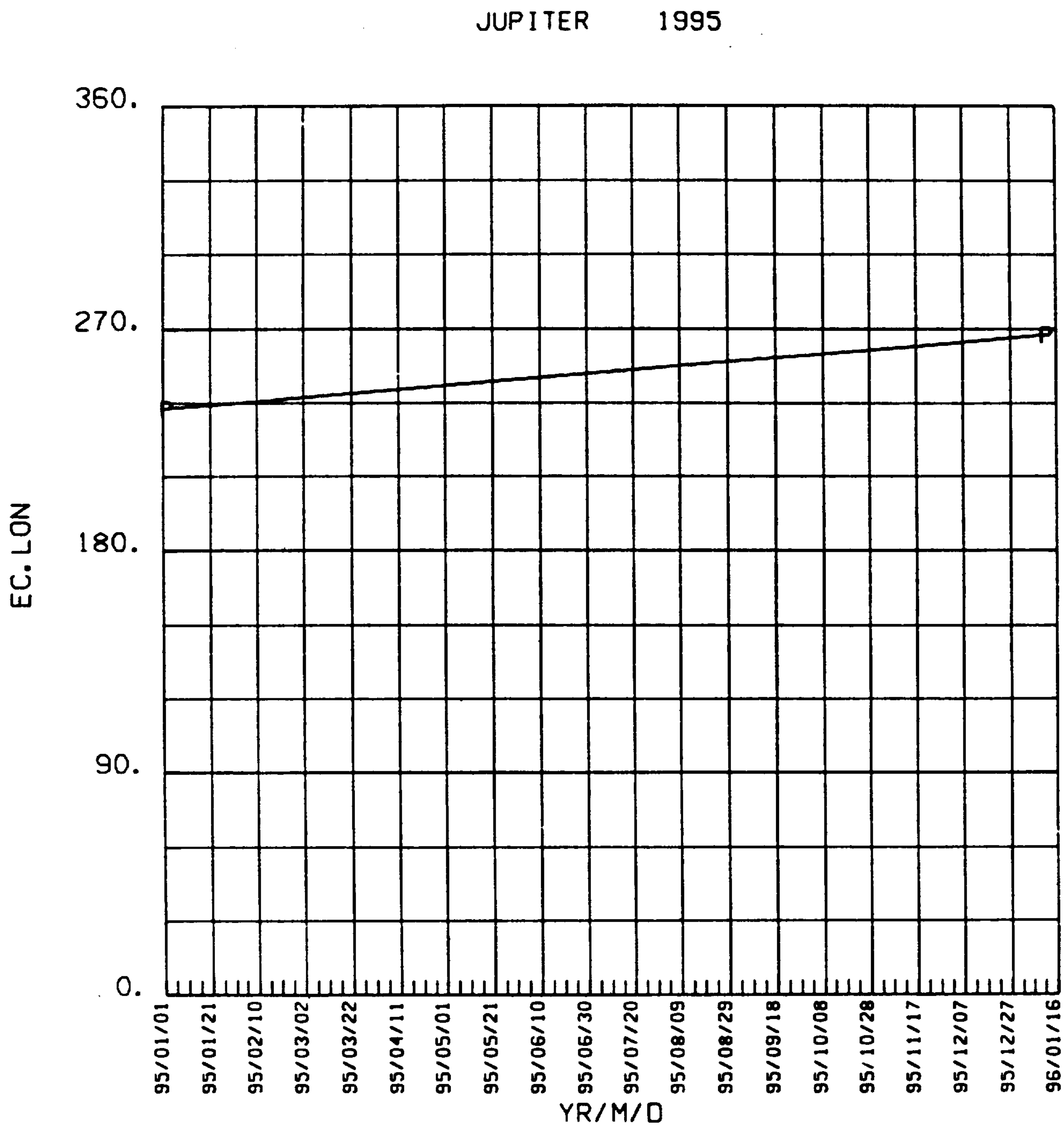
95/01/16

JUPITER 1995



JUPITER 1995




JUPITER 1995
360.
270.
180.
90.
0.
EC. LON
95/01/01
95/01/21
95/02/10
95/03/02
95/03/22
95/04/11
95/05/01
95/05/21
95/06/10
95/06/30
95/07/20
95/08/09
95/08/29
95/09/18
95/10/08
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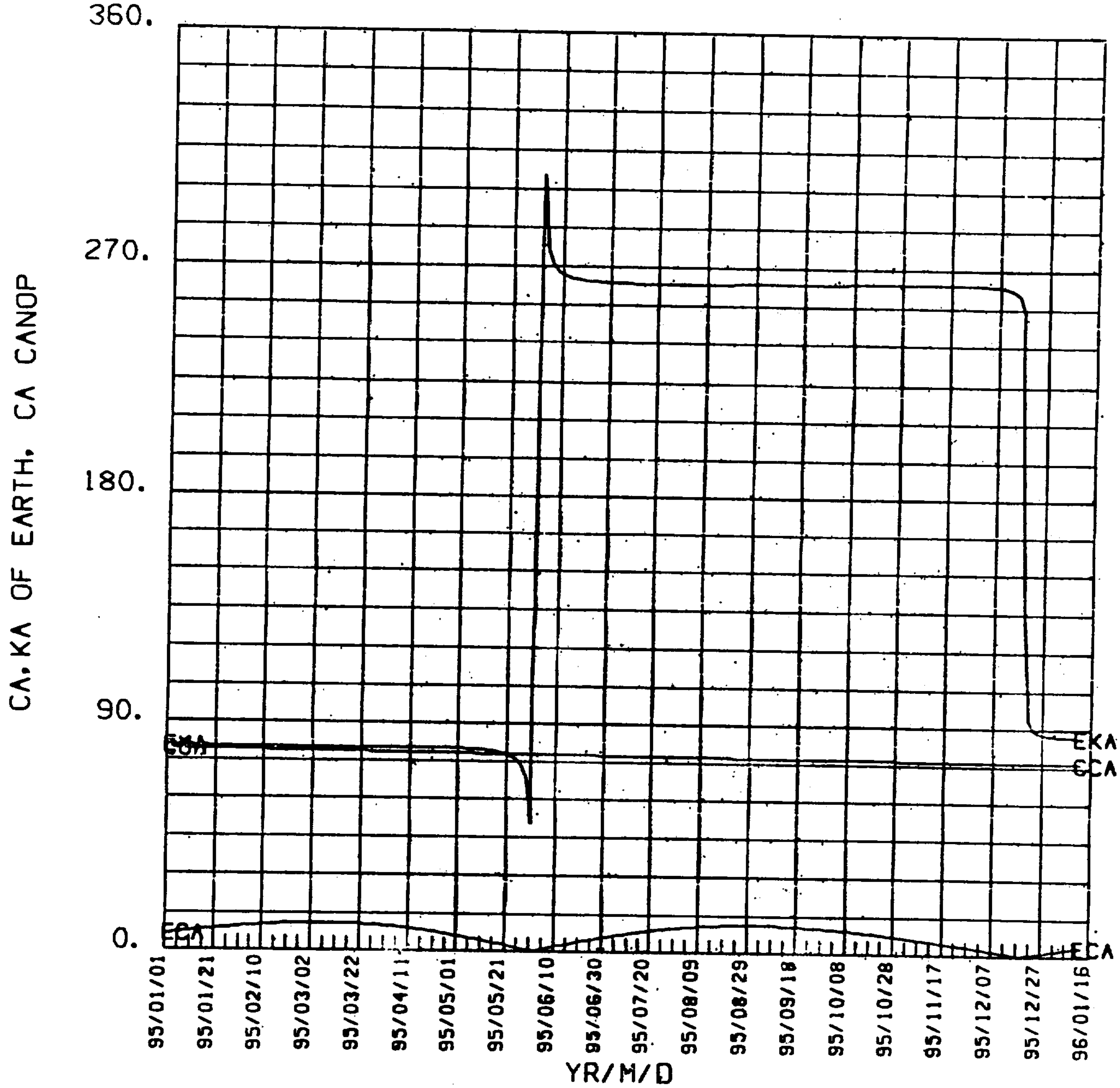
95/12/07
95/12/27
96/01/16
YR/M/D

JUPITER 1995



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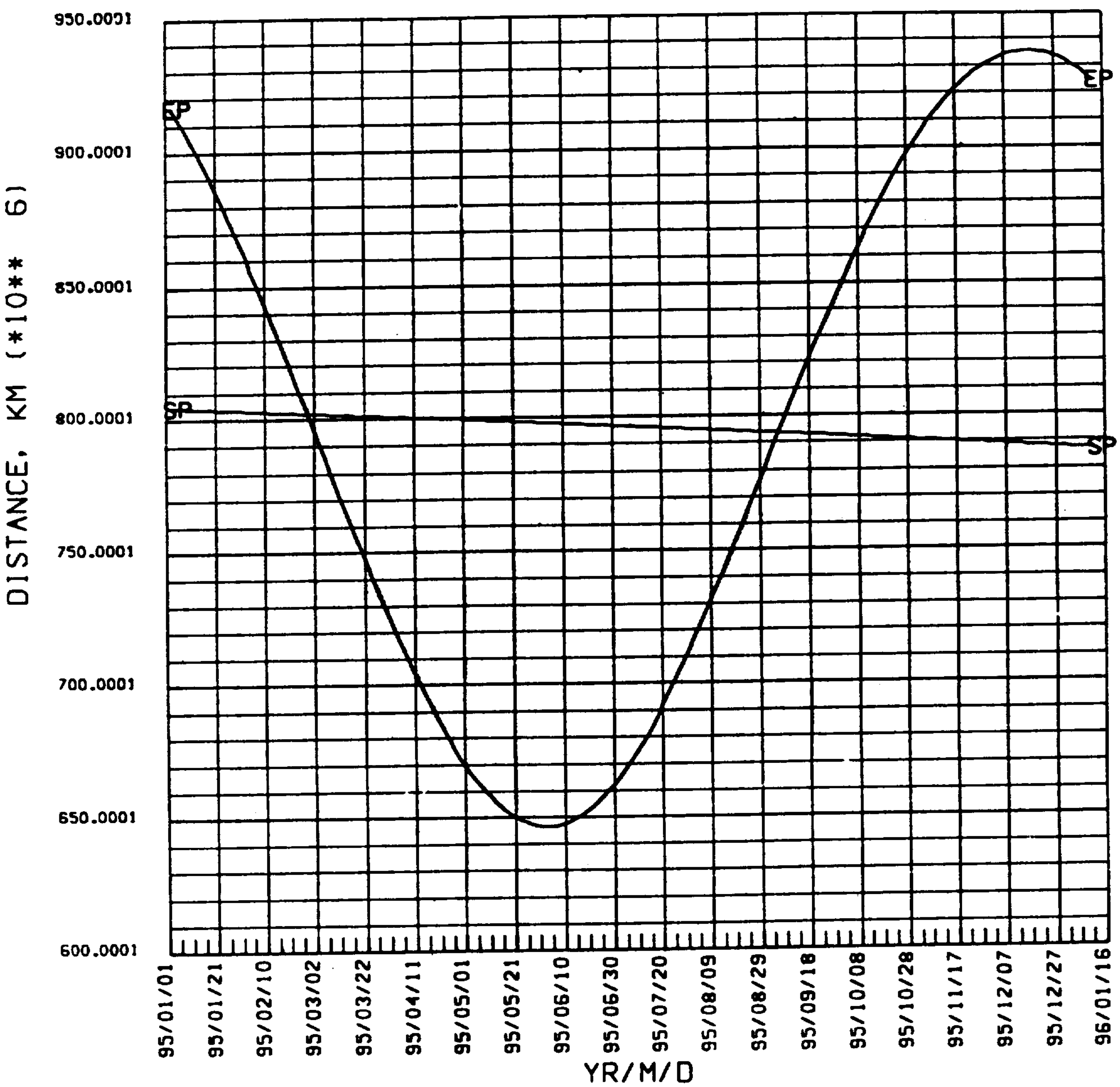

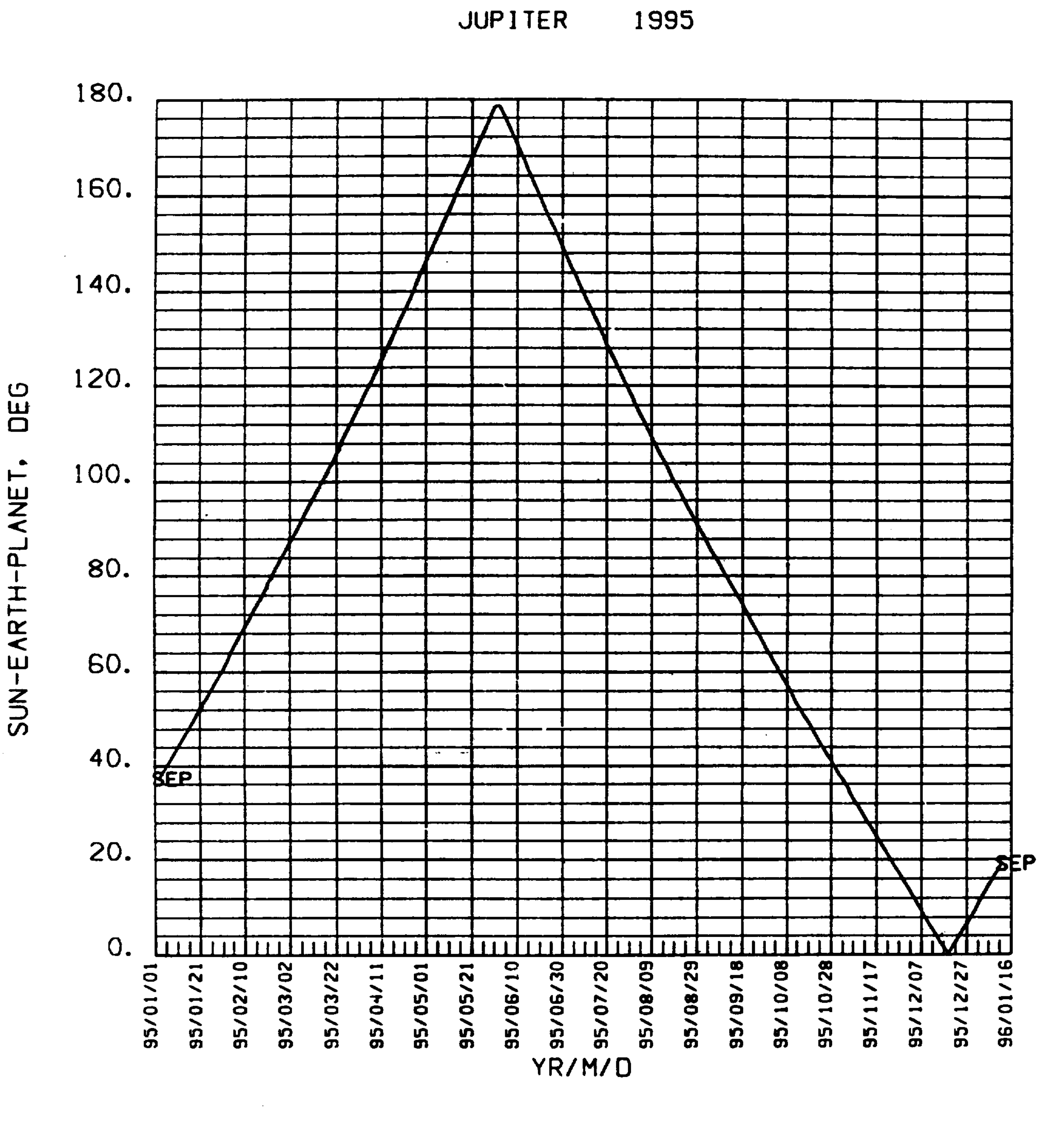
JUPITER 1995
SUN-EARTH-PLANET, DEG
180.
160.
140.
120.
100.
80.
60.
40.
20.
0.
SEP
SEP
95/01/01
95/01/21
95/02/10
95/03/02
95/03/22
95/04/11
95/05/01
95/05/21
95/06/10
95/06/30
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95/12/27
96/01/16
YR/M/D

JUPITER 1995